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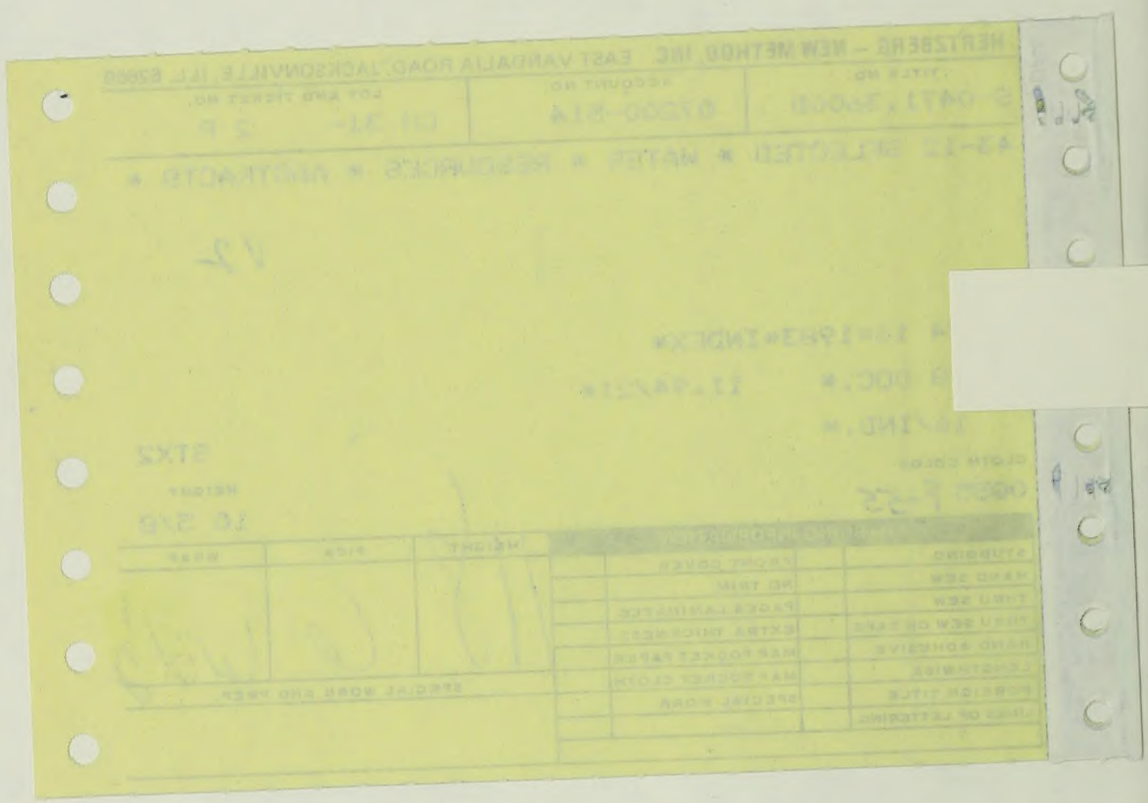
SELECTED WATER RESOURCES ABSTRACTS

VOLUME 16, NUMBER 9
SEPTEMBER 1983

W83-02801 -- W83-03150
CODEN: SWRABW



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SELECTED WATER RESOURCES ABSTRACTS

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SELECTED WATER RESOURCES ABSTRACTS (SWRA) is produced by the Geological Survey, U.S. Department of the Interior, and published monthly by the National Technical Information Service (NTIS), U.S. Department of Commerce.

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 16, NUMBER 9
SEPTEMBER 1983

W83-02801 -- W83-03150

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Directory of the Office of Management and Budget through September 30, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
Reston, VA 22092

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

HYDROLOGIC AND WATER QUALITY MODELING FOR INSTREAM FLOW STRATEGIES,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 6C.
W83-02927

WATER RESOURCES AND DATA-NETWORK ASSESSMENT OF THE MANASOTA BASIN, MANATEE AND SARASOTA COUNTIES, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7A.
W83-02973

HYDROLOGY OF THE SURFICIAL AQUIFER IN THE FLOYD RIVER BASIN, IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W83-02993

FLOW DURATION CURVES IN TROPICAL EQUATORIAL REGIONS,
Shawinigan Engineering Co. Ltd., Montreal (Quebec).
For primary bibliographic entry see Field 2E.
W83-03018

CONTEMPORARY STOCHASTIC APPROACH TO WATER RESOURCE SYSTEMS: THE ARMP AND FEATURE PREDICTION MODELS,
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
O. Ibidapo-Obe.
Advances in Water Resources, Vol 5, No 4, p 236-239, December, 1982. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Stochastic hydrology, *Water resources development, Markovian parameters, Discharge measurements, Dams, Hydrology, Mathematical studies, Stochastic process, Probabilistic process, Nile River, Aswan Dam, Egypt.

An Autoregressive model with Markovian parameters (ARMP/a.r.m.p.) and a feature prediction scheme (FRM) are developed. The ARMP is physically based and adaptive in is implementation, thus taking into consideration the inherent periodicities in hydrological time series. The FRM is motivated by the current inability to provide a suitable and sufficiently comprehensive yet simplified mathematical-hydrological model. It is based on pattern analysis and is such that a system's dynamic feature is predicted using a priori data which can subsequently be used to simulate the missing data and forecast future hydological parameters. The ARMP and FPM provide efficient alternatives to some other existing models which are not, in general, applicable to all classes of hydrological problems, with an added advantage of on-line forecasting. A comparitive analysis of the techniques was undertaken using the discharge record data from the River Nile at Aswan Dam from 1870 to 1945. It is further proposed that in order to enhance the overall performance of the prediciton scheme the FPM may be used as an input (training data) to the ARMP. It is expected that the application of these techniques to the analysis and synthesis of stream flows would yield very useful results in the design and operation of several hydraulic structures. The a.r.m.p. and the feature prediction techniques may be applied to other random processes in control, communication, physiological and other systems. (Baker-FRC)
W83-03060

COMPARING METHODS OF HYDROLOGIC REGIONALIZATION,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W83-03146

2B. Precipitation

SEASONAL PATTERNS IN EXTREME 1-HOUR RAINFALLS,
Meteorological Service, Wellington (New Zealand).
K. J. A. Revfeim.
Water Resources Research, Vol 18, No 6, p 1741-1744, December, 1982. 1 Tab, 4 Ref.

Descriptors: *Seasonal variation, *Rainfall, Rainfall intensity, Model studies, Stochastic process.

The information content of monthly rainfall extremes is used to estimate simple harmonic coefficients of a rainfall model. Extreme rainfalls are assumed to occur as a periodic Poisson process with time-varying rate annd independent exponentially distributed amounts, where the mean of the exponential distribution also varies with a period of one year. Amplitudes of both recurrence and intensity were found to be significantly different from zero for a 31-year by 12-month record of 1-hour rainfall extremes. The phases of recurrence and intensity differ by approximately 6 months, so that the extreme events within a given time period are obtained using the monthly data base rather than the series of annual extremes. (Author's abstract)
W83-02932

2C. Snow, Ice, and Frost

NATURE AND EXTENT OF ACID SNOWPACKS IN PENNSYLVANIA,
Pennsylvania State Univ., University Park.
D. R. DeWalle, W. E. Sharpe, J. Izbicki, and D. L. Wirries.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206276, Price codes: A03 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources Completion Report, Pennsylvania State Univ., University Park, February 1983. 35 p, 7 Fig, 5 Tab, 13 Ref, 1 Append. OWRT A-054-PA(1), 14-34-0001-9040.

Descriptors: *Acid rain, *Atmospheric deposition, *Snowpacks, *Sulfate, *Nitrate, *Lime dust, Hydrogen ions, Lead, *Pennsylvania, Ridge and Valley Province, Water quality, Ion balance, Quarries, Air quality, Water equivalent, Storm track, Snowfall, Heavy metals, Forests, *Hydrogen ion concentration.

Snowpack chemistry was evaluated with repeated surveys at 30 sampling sites across Pennsylvania during 1979-81. The mean snowpack pH of 4.25 for 280 samples was largely due to H+ from nitric acid. Snowpack sulfates were high, especially in the SW sector of the state where SO sub 2 emissions were also high, but did not originate only from sulfuric acid. Rain-on-snow and coastal storm snowpacks produced higher snowpack pH. Localized increases in snowpack pH were found due to additions of dust from limestone and dolomite quarry operations, especially in the central Ridge and Valley Province. Acid loading on the landscape from snow in Pennsylvania is controlled by the total amount of snowfall as well as variations in concentrations of chemical constituents. Lead concentrations in snow packs occasionally exceeded maximum contaminant levels prescribed for drinking water.
W83-02943

TRANSPORT OF WATER IN FROZEN SOIL: I. EXPERIMENTAL DETERMINATION OF SOIL-WATER DIFFUSIVITY UNDER ISOTHERMAL CONDITIONS,
Cold Regions Research and Engineering Lab., Hanover, NH.
Y. Nakano, A. Tice, J. Oliphant, and T. Jenkins.
Advances in Water Resources, Vol 5, No 4, p 221-226, December, 1982. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Mathematical equations, *Water transport, *Frozen ground, Isotherms, Permeability coefficient, Temperature effects.

A new experimental method for measuring the soil-water diffusivity of frozen soil under isothermal conditions is introduced. The theoretical justification of the method is presented, and the feasibility of the method is demonstrated by experiments conducted using marine deposited clay. The theorectical justification is made under the assumption that the soil-water diffusivity is proportional to some power of water content. This functional form of the soil-water diffusivity does not provide a close fit for the experimental data obtained. Thus the measured diffusivity must be considered approximate. The approximation was needed in analyzing experimental data because the mathematical theorems available at present are limited. Mathematical theorems for the more general case of diffusivity function are required to improve the accuracy in data analysis. (Baker-FRC)
W83-03054

MOBILIZATION, MOVEMENT AND DEPOSITION OF ACTIVE SUBAERIAL SEDIMENT FLOWS, MATANUSKA GLACIER, ALASKA,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2J.
W83-03116

CHEMISTRY OF SOUTH POLAR SNOW,
Laboratoire de Glaciologie et Geophysique de l'Environnement, Grenoble (France).
For primary bibliographic entry see Field 2K.
W83-03119

2D. Evaporation and Transpiration

WEATHER AND CONSUMPTIVE USE IN THE BEAR RIVER BASIN, IDAHO DURING 1982,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
R. G. Allen, and C. E. Brockway.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-202317. Idaho Water and Energy Resources Research Institute Completion Report, Univ. of Idaho, Moscow, January 1983. 107 p, 60 Fig, 6 Tab, 15 Ref, 1 Append. OWRT A-076-IDA(1), 14-34-0001-2114.

Descriptors: *Idaho, *Consumptive use, *Weather, Evapotranspiration, *Irrigation, *Dryland, Soil moisture, Neutron problem, Aridity, Wind, Temperature, Vapor pressure, Alfalfa, Winter wheat, Bear River basin, *Solar radiation.

Hourly measurements of solar radiation, wind travel, air temperature and dewpoint temperatures were recorded at three agricultural sites in the Bear River basin in Idaho during 1982. Evapotranspiration calculated from the water measurements using a Penman combination equation agreed well with soil moisture depletions measured with a neutron-probe at an irrigated alfalfa site. Advection-aridity relationships describing water use by dryland crops based on the microclimate environment estimated consumptive use quite well for dryland winter wheat and dryland alfalfa during most months. The SCS-Blaney-Criddle consumptive use method under-estimated water use by irrigated alfalfa but provided good estimates of water use by dryland winter wheat. The FAO-Blaney-Criddle method with elevation correction provided estimates equivalent to the Penman method. Weather and calculated evapotranspiration estimates in the Bear River portion of Idaho were similar to measurements recorded at Kimberly, Idaho, 240 km to the west, during the same time period, but were quite different from measurements recorded at Logan, Utah, 30 to 90 km to the south.
W83-02911

EVAPORATIVE FLUX FROM WHEAT AND FALLOW IN A SEMIARID CLIMATE,

Montana Agricultural Experiment Station, Bozeman.
J. K. Aase, and F. H. Siddoway.
Soil Science Society of America Journal, Vol 46, No 3, p 619-626, May/June, 1982. 12 Fig, 3 Tab, 15 Ref.

Descriptors: *Water stress, *Evapotranspiration, *Soil-water-plant relationships, Evaporation, Semiarid lands, Wheat, Fallowing, Water use efficiency, Energy loss, Dry farming, *Montana, Soil moisture.

The daily evaporative flux and energy balance components were measured in two adjacent 180m x 180m fields in Montana. The fields were alternately cropped and fallowed. Plantings were Olaf spring wheat in 1978 and 1979 and Roughrider winter wheat in 1979-1980. Rainfalls in the crop seasons were 33 cm in 1978 and 9 cm in each of 1979 and 1980. In spite of deficient precipitation in 1979 the crop was normal (4000 kg per ha) because the root zone soil profile was near field capacity in the spring. The 1980 crop was 1/3 that of the 1979 crop. Lysimeters in fallow and planted fields lost almost identical amounts of water until completion of tillering. Thereafter, evapotranspiration from cropped fields was much higher than evaporation from fallow fields. The fallowed lysimeter gained 12 cm of water in 1978, lost 7 cm in 1979, and lost 2,5 cm in1980. The cropped lysimeter lost 20 cm in 1978, 42 cm in 1979, and 14 cm in 1980. Sensible heat transfer to the crop strongly influenced evapotranspiration, except in 1980 when the crop was water stressed and contributed sensible heat downwind from the field. (Cassar-FRC)
W83-02965

EVAPOTRANSPIRATION BEFORE AND AFTER CLEARING PHREATOPHYTES, GILA RIVER FLOOD PLAIN, GRAHAM COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
R. C. Culler, R. L. Hanson, R. M. Myrick, R. M. Turner, and F. P. Kipple.
Available from the Distribution Br. USGS, 604 S. Pickett St. Alexandria, VA 22304, Price, $9.00. Geological Survey Professional Paper 655-P, 1982. 67 p, 25 Fig, 1 Plate, 21 Tab, 39 Ref.

Descriptors: *Evapotranspiration, *Phreatophytes, *Hydrologic budget, Energy, Flood plains, Vegetation, Soil moisture, Water conservation, *Arizona, Graham County, Gila River Phreatophyte Project, San Carlos Indian Reservation.

The U.S. Geological Survey made a water-budget study of evapotranspiration along a 15-mile reach of the Gila River, Arizona from 1962 to 1971. The study was designed to determine the change in evapotranspiration following phreatophyte removal from the river's flood plain. After an initial calibration period, the vegetation was removed beginning in 1967. Post-clearing attempts to establish grass were unseccessful and ephemeral plants provided the only plant cover during brief periods of moisture availability after clearing. The report shows that annual evapotranspiration on the project area averaged 43 inches before clearing, ranging from 56 inches for dense stands of phreatophytes to 25 inches on areas of no phreatophytes. After phreatophyte removal the average reduction in evapotranspiration was 19 inches per year and ranged from 14 inches to 26 inches depending on the density of phreatophytes prior to removal. The report notes that a flood plain without phreatophytes is in an artificial condition and that the reduced evapotranspiration is temporary and would not apply after permanent replacement vegetation became established. (USGS)
W83-02966

EVAPOTRANSPIRATION OF APPLIED WATER, CENTRAL VALLEY, CALIFORNIA, 1957-78,
Geological Survey, Sacramento, CA. Water Resources Div.
A. K. Williamson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-263385, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-45, May 1982. 56 p, 11 Fig, 4 Tab, 30 Ref.

Descriptors: *Evapotranspiration, *Groundwater recharge, *Irrigation, *Water management, Hydrologic budget, Consumptive use, Irrigation efficiency, *California, Central Valley.

In the Central Valley, Calif., where 57% of the 20,000 square miles of land is irrigated, groundwater recharge from agricultural lands is an important input to digital simulation models of groundwater flow. Several methods of calculating recharge were explored for the Central Valley Aquifer Project and a simplified water budget was designed where net recharge (recharge minus pumpage) equals net surface water diverted minus evapotranspiration of applied water (ETAW). This equation eliminates the need to determine pumpage from the water-table aquifer, assuming that the time lag for infiltration is not longer than the time intervals of interest for modeling. This study evaluates only the evapotranspiration of applied water. Future reports will describe the other components of the water budget. ETAW was calculated by summing the products of ETAW coefficients and respective crop areas for each 7 1/2-minute quadrangle area in the valley, for each of three land-use surveys between 1957 and 1978. In 1975 total ETAW was 15.2 million acre-feet, a 43% increase since 1959. The largest increases were in the south, especially Kern County, which had a sixfold increase, which was caused by the import of surface water in the California Aqueduct. (USGS)
W83-02984

AN EXPERIMENTAL INVESTIGATION OF EVAPOTRANSPIRATION ESTIMATION METHODS,
Minnesota Univ., St. Paul. Dept. of Soil Science.
J. E. Ljungkull, and D. G. Baker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206813, Price codes, A08 in paper copy, A01 in microfiche. M.S. Thesis, August 1982. 143 p, 43 Fig, 15 Tab, 108 Ref, 8 Append. OWRT B-147-Minn(2), 14-34-0001-9119.

Descriptors: *Evapotranspiration, *Calculation methods, *Lysimeter, Evaporation, Transpiration, Hydrologic Cycle, Minnesota, Regression analysis, Pan evaporation, *Meteorological data, Soybeans, Alfalfa.

Using meteorological data collected during the 1978, 1979, and 1980 growing seasons at St. Paul, MN, estimates of daily potential evapotranspiration were made using thirteen different calculation methods. These estimates were then compared to measurements of actual evapotranspiration from a cropped surface obtained from the University of Minnesota's weighing lysimeter. The crop was soybeans in 1978 and 1979, and alfalfa 1980. Simple linear regression techniques were used to compare the estimated and measured values of evapotranspiration. Scatter plots showing the relationships between the predicted and observed values and histograms of the differences between the two are presented. Summary statistics for each regression and set of difference values are reported. It was found that pan evaporation was most successful at predicting daily evapotranspiration. The methods which combine energy balance and aerodynamic functions were the next best, followed by the methods using radiation and temperature as inputs. The methods based on temperature alone performed most poorly.
W83-03034

2E. Streamflow and Runoff

APPLICATION OF NUMERICAL SIMULATION TECHNIQUES TO FLOODPLAIN MANAGEMENT,
Nevada Univ. System, Reno. Desert Research Inst.
V. L. Gupta, J. W. Fordham, S. M. Afag, and J. M. Federici.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196451, Price codes: A03 in paper copy, A01 in microfiche. Publication No 41080, Janaury 1983. 40 p, 4 Tab, 13 Fig, 19 Ref, 2 Append. OWRT B-096-NEV(2), 14-34-0001-7168.

Descriptors: *Floodplains, Floodplain studies, *Flood routing, Flood waves, Design flood, *Floodplain management, Numerical analysis, Finite difference method, *Simulation, *Sensitivity, Model studies, Tuckee River, *Nevada.

Presented herein is a case study of one dimensional modeling of spatially varied unsteady flow for the Truckee River. The study attempts to refine the currently used techniques in defining the floodplain for key reaches under various levels of flooding. Several different finite difference formulations of the Saint-Venant equations were compared for efficiency and sensitivity to various input parameters in an effort to identify the key parameters which determine model reliability. The basic model was found to be capable of reproducing historic floods and short duration hydrographs. The sensitivity analysis indicated that the most influential input parameter was the lateral flow regime. Therefore it is determined that an explicit description of tributary inputs is necessary together with adequate geometric description in the immediate vicinity of the confluence. With an adequate lateral inflow description the model was used to delineate the Standard Project and Intermediate Floodplains.
W83-02893

TURBULENT VERTICAL MOMENTUM TRANSFER IN STRATIFIED ENVIRONMENTS,
Nevada Univ. System, Las Vegas. Desert Research Inst.
R. H. French, and S. C. McCutcheon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196634, Price codes: A03 in paper copy, A01 in microfiche. Publication No 41079, March 1983. 32 p, 3 Fig, 5 Tab, 17 Ref. OWRT A-099-Nev(1), 14-34-0001-1130.

Descriptors: *Stratified flow, *Turbulent flow, *Momentum transfer, *Error analysis, Vertical mixing, Boundary layer vertical momentum, Hydraulics, Estuarine circulation.

A uniform data base is used to compare five hypotheses of vertical momentum transfer in stratified free surface flow in which the primary source of turbulence is bottom boundary shear. The hypotheses examined includes those of Rossby and Montgomery, Kent and Pritchard, Odd and Rodger, French, and McCutcheon. Of the hypotheses examined, four involve one or more free coefficients while the hypothesis of McCutcheon involves no free coefficients. Two general conclusions can be drawn. First, although the hypothesis of French yields excellent estimates of epsilon super s, this is an empirical theory whose coefficient values and accuracy should be verified with an independent data set. Second, the modified hypothesis of McCutcheon provides very reasonable estimates of epsilon super s especially when it is considered that this model involves no free coefficients. In comparing these hypotheses, the problem of experimental error was also considered. It is concluded that the traditional theories of mementum transfer in stratified flows all suffer from severe computational error problems. In fact, these difficulties are so severe that this factor alone may account for the problems other investigators have encountered in accurately determining values for the free coefficients.
W83-02901

HYDROLOGY, HYDRAULICS, AND SEDIMENT TRANSPORT, KANKAKEE AND IROQUOIS RIVERS,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2J.
W83-02921

DEVELOPMENT OF A GENERALIZED HYDROLOGIC MODELLING SYSTEM,

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
E. H. Wiser.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206300, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, North Carolina State Univ., Raleigh, March 1983. 32 p, 8 Ref, 2 Append. OWRT A-097-NC(1), 14-34-0001-7070.

Descriptors: *Hydrologic models, *Stream discharge, Simulation analysis, Stream Flow, Simulation of stream flow, Model studies, *North Carolina, Streamflow data.

A system has been developed to permit convenient simulation of streamflow data at any point in the state of North Carolina. The user can by interactive use of a terminal specify watershed location and area, model and parameters for simulation at the point. The system is known as HMS (Hydrologic Modelling System). HMS leads the user through a series of questions by which the location, drainage area, model and parameters are determined. The user is always permitted to accept default values or modify parameters as desired. If the user can identify the location according to the labels used in the preceding NCSSARR study, the basin can be immediately specified. If not, a map of the state is used by which the appropriate basin code can be determined. The project as originally proposed was a comprehensive one, assuming the introduction of several models, devising methods of relating model parameters to watershed characteristics, and testing the models under various conditions. The project as finally approved is much more limited in scope. Only one model is included, information on selecting parameters is more limited, and no testing has been done. However, it is believed that the project has shown that the method is appropriate, at least for some models, and it certainly makes modelling more accessible.
W83-02946

STREAMFLOW CHARACTERISTICS RELATED TO CHANNEL GEOMETRY OF STREAMS IN WESTERN UNITED STATES,
Geological Survey, Lawrence, KS. Water Resources Div.
E. R. Hedman, and W. R. Osterkamp.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.25. Geological Survey Water-Supply Paper 2193, 1982. 17 p, 9 Fig, 3 Tab, 16 Ref.

Descriptors: *Streamflow, *Flow characteristics, *Channel morphology, *Streams, Flood frequency, Gaging stations, Hydrologic data, Surface water, Rainfall-runoff relationships, *Western United States, Active-channel geometry.

Assessment of surface-mining and reclamation activities generally requires extensive hydrologic data. Adequate streamflow data from instrumented gaging stations rarely are available, and estimates of surface-water discharge based on rainfall-runoff models, drainage area, and basin characteristics sometimes have proven unreliable. Channel-geometry measurements offer an alternate method of quickly and inexpensively estimating streamflow characteristics for ungaged streams. The method uses the empirical development of simple or multiple regression equations to yield a discharge value from channel-geometry and channel-material data. The equations are developed by collecting data at numerous stream-gaging sites and statistically relating those data to selected discharge characteristics. Mean annual runoff and flood discharges with selected recurrence intervals can be estimated for perennial, intermittent, and ephemeral streams. The equations were developed from data collected in the western half of the conterminous United States. The effects of the channel-material and runoff characteristics are accounted for with the equations. (USGS)
W83-02969

STREAMFLOW LOSSES TO MADISON GROUP ROCKS IN THE LITTLE BELT AND BIG SNOWY MOUNTAINS, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. D. Feltis, and R. R. Shields.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-117929, Price codes: A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-49, August 1982. 16 p, 3 Fig, 7 Tab, 7 Ref.

Descriptors: *Streamflow depletion, *Stream discharge, *Flow measurement, *Flow rates, Data collections, Gaging stations, Sites, *Montana, Madison Group rocks, Little Belt Mountains, Big Snowy Mountains.

Four streams originating in the Little Belt and Big Snowy Mountains in central Montana were measured in 1975 to determine streamflow losses across outcrops of the Madison Group (Mississippian age). Based on streamflow data obtained for 39 months at two streamflow-gaging stations on the Middle Fork Judith River, the average daily loss was 9.1 cubic feet per second or about 6,600 acre-feet per year. Seepage measurements on other stream reaches indicated losses of 7.6 cubic feet per second on the south Fork Judith River, 9.2 cubic feet per second in Yogo Creek, as much as 64 cubic feet per second in Dry Wolf Creek, and about 60 cubic feet per second in Rock Creek. (USGS)
W83-02974

TECHNIQUES FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS IN SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
B. H. Whetstone.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-118281, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-1, February 1982. 78 p, 13 Fig, 3 Tab, 7 Ref.

Descriptors: *Floods, *Frequency analysis, *Flood data, Streamflow, Regulated flow, Flood discharge, Flood peak, Gaging stations, Sites, *South Carolina.

Information is presented for estimating the magnitude and frequency of floods on streams in South Carolina. Flood-frequency characteristics for 151 gaging stations, were related to basin characteristics by multiple regression techniques for each of four physiographic provinces. Equations were derived to estimate flood magnitudes at recurrence intervals ranging from 2 to 100 years on streams with drainage areas greater than 1.0 square mile. Examples demonstrate the procedure for computing flood-frequency discharge for sites on gaged and ungaged streams in South Carolina. Relationships of flood discharge and frequency to drainage area are presented for the main stem of major streams. A compilation of flood records for gaging stations in South Carolina is presented as supplemental data. (USGS)
W83-02979

TECHNIQUES FOR ESTIMATING FLOOD DISCHARGES FOR UNREGULATED STREAMS IN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
R. P. Thomas, and R. L. Gold.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-264953, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigation 82-24, March 1982. 42 p, 2 Fig, 5 Tab, 23 Ref.

Descriptors: *Floods, *Streams, *Flood peak, *Regression analysis, *Data collections, Simulation analysis, Estimating, Flood recurrence interval, Flood frequency, Gaging stations, Sites, *New Mexico.

Equations for estimating flood magnitudes at selected recurrence intervals from 2 to 500 years were developed using multiple-regression analyses. These equations relate flood magnitudes to basin characteristics, contributing drainage area and site altitude, and only are applicable to unregulated streams in New Mexico that are relatively unaffected by urban runoff. Estimates of floods at or near gaged sites may be computed with an equation that adjusts discharges developed with the regression equations using station-specific discharges. (USGS)
W83-02981

FLOODS IN MAINE, APRIL-MAY 1979,
Geological Survey, Augusta, ME. Water Resources Div.
R. A. Fontaine, and C. R. Haskell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-109454, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-68, November 1981. 65 p, 8 Fig, 2 Tab, 1 Append.

Descriptors: *Floods, *Excess rainfall, *Snowmelt, *Hydrologic data, Runoff, Flood peak, Flood recurrence interval, Flood damage, Flood discharge, Storms, Gaging stations, Sites, *Maine.

Heavy rainfall during April 27-30, 1979, resulted in moderate to record flooding in much of northern and western Maine. During this period, rainfall totals of as much as 6 inches were measured. This period was preceded by up to 10 days of seasonally warm temperatures and snowmelt, which helped create conditions favorable to flooding later in the month. Flood peaks having recurrence intervals greater than 30 years were recorded at several sites, and a few sites experienced maximum recorded flood peaks with recurrence intervals in excess of 50 years. There was no loss of life, but local damage to homes and commercial and industrial establishments was significant. This report describes the flooding. A tabulation of peak gage heights and discharges is included for 42 sites. Daily and storm precipitation values are tabulated for 58 sites. (USGS)
W83-02983

STORAGE REQUIREMENTS TO SUSTAIN GROSS RESERVOIR OUTFLOW FROM SMALL BASINS IN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
W. J. Carswell, Jr.
Kansas Water Resources Board Technical Report No 16, June 1982. 40 p, 18 Fig, 3 Tab, 8 Ref.

Descriptors: *Reservoir storage, *Small watersheds, *Carryover storage, Storage capacity, Streamflow, Annual runoff, Frequency distribution, Data collections, *Kansas, Probability routing.

Carryover and within-year storage requirements were used to determine the total storage required to sustain gross reservoir outflow from small basins in Kansas. Carryover storage requirements were defined using the probability-routing method and annual streamflows for unregulated streams with drainage areas of less than 300 square miles. Mass curve analysis of streamflows for each year was used to define within-year storage requirements. From these results, regional draft-storage curves for 2-, 5-, and 10-% chances of deficiency were developed and are presented as three-parameter plots of draft rate against mean annual runoff for selected levels of storage. These curves can be used to estimate the storage required to sustain gross reservoir outflow at sites where continuous streamflow records are not available. An evaluation of the accuracy of sustained gross reservoir outflow for a 2-% chance of deficiency calculated from regional relations indicated a root-mean-square error of 26%. Relations are included that can be used as a rough approximation to adjust draft-storage curves at ungaged sites for the effect of serial correlation. (USGS)
W83-02992

FLOW DURATION CURVES IN TROPICAL EQUATORIAL REGIONS,
Shawinigan Engineering Co. Ltd., Montreal (Quebec).
S. I. Ramsahoye.

International Water Power and Dam Construction, Vol 34, No 12, p 66-69, December, 1982. 3 Fig, 1 Tab, 5 Ref.

Descriptors: *Tropical regions, *Flow duration, *Streamflow forecasting, Rainfall-runoff relationships, Runoff, Surface runoff, Developing countries.

Development of hydropower in developing countries requires streamflow data, which is usually unavailable or inadequate for the ungaged upper catchments and mountains regions of the basins. A method of obtaining flow duration bypasses the usual streamflow simulation and uses the mean annual flow to calculate the average daily flow duration curve. Several approaches are given for computing the mean annual runoff. These recognize that incident annual solar radiation is reasonably constant and that runoff can be calculated from rainfall and temperature data. Preparation of the flow duration curve depends on the fact that flow duration coefficients are reasonably constant within a country or region of a country. The ratio of the theoretical to the measured flow for a selected % of flow exceedance is also reasonably constant. This permits preparation of average daily or monthly flow duration curves using short-term flows and long-term rainfall and temperature. This rapid method requires only a hand-held calculator. It cannot be used in regions where groundwater inflows or outflows are significant without adjustments for this component. (Cassar-FRC)
W83-03018

2F. Groundwater

UPDIP DELINEATION OF THE TERTIARY LIMESTONE AQUIFER, SOUTH CAROLINA,
South Carolina Univ., Columbia. Dept. of Geology.
D. J. Colquhoun, R. W. Oldham, J. W. Bishop, and P. D. Howell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196485, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 97, Univ. of South Carolina, Columbia, December, 1982. 93 p, 4 Fig, 10 Ref. OWRT A-055-SC(1), 14-34-0001-2143.

Descriptors: *Catchment area, *Confined aquifer, *Confining beds, *Groundwater recharge, Geologic time, *Geologic mapping, Geologic units, Subsurface mapping, *Tertiary limestone aquifer, *South Carolina, Cooper Group, Orangeburg Group, Black Mingo Group, Middle Eocene, Late Eocene, Olilgocene, Paleocene, Santee Limestone.

The Tertiary Limestone Aquifer is delineated in its updip area of South Carolina within the Orangeburg Group of middle Eocene (Claibornian, Lutetian) Age. The Orangeburg Group lies above the Black Mingo Group of Paleocene (Midwayian, Sabinian, Danian, Thanetian) and early Eocene (Wilcoxian, Ypresian) Age, and is separated by regional erosional unconformity. The Orangeburg Group lies below the Cooper group of Late Eocene (Priabonian/Bartonian) and Oligocene (Chattian) Age, and is separated by regional erosional unconformity. The Orangeburg Group results from marine submergence and emergence. It consists of several regionably mappable formations. From South (basinward) to North (source area ward) the Santee Limestone thins as over- and underlying siliciclastic formations thicken. The sequence below consists of Santee Limestone (carbonate shelf), Bamberg, formation (deep water siliciclastic shelf), Neeses formation and Congaree Formation (shallow water siliciclastic shelf). The sequence above consists of Santee Limestone and McBean Formation. North of the Santee Limestone pinchout Aiken formation is recognized where over- and underlying siliciclastic shelf units cannot be separated. The Aiken is generally of barrier complex origin. Recharge-discharge areas within and into the Tertiary Aquifer are mapped, both below and above the Orangeburg Group through examination of power auger, outcrop and geophysical logs of water and test wells.
W83-02896

AQUIFER PARAMETER PREDICTION BY NUMERICAL MODELING,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
M. M. Aral, and E. L. Kuniansky.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-202325, Price codes: A05 in paper copy, A01 in microfiche. Environmental Resources Center Report No. ERC 02-83, Georgia Institute of Technology, Atlanta, March 1983. 83 p, 36 Fig, 51 Ref. OWRT A-091-GA(1), 14-34-0001-1111.

Descriptors: *Groundwater seepage, *Finite element method, *Aquifer parameter, Model studies, Transmissivity, Regression analysis, Algorithm.

The research analyzes two approaches which may be utilized in determining the two-dimensional areal description of transmissivity in a heterogeneous aquifer. Both approaches rely on accurate steady-state piezometric head data. The first approach involved the direct solution of the steady state groundwater seepage equation with transmissivity parameter chosen as the primary unknown. The Galerkin finite element method was used for this purpose, but proved to be numerically unstable for this problem. The second method examined was a nonlinear least squares regression technique combined with finite element solution of steady state groundwater seepage equation with piezometric head chosen as the primary unknown parameter. This is an iterative approach which automates the trial and error model calibration process. The technique is applied to field problems with considerable success and the algorithm shows promise as a viable alternative to manual trial and error approach.
W83-02912

DERIVATION OF VERTICALLY AVERAGED EQUATIONS DESCRIBING MULTIPHASE FLOW IN POROUS MEDIA,
Princeton Univ., NJ. Dept. of Civil Engineering.
W. G. Gray.
Water Resources Research, Vol 18, No 6, p 1705-1712, December, 1982. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Porous media, *Aquifers, *Groundwater movement, Representative elementary volume technique.

An extension of the REV (representative elementary volume) averaging technique, used to derive balance equations for multiphase or porous media flow problems, is presented. Theorems which allow a one-step transformation from three-dimensional point equations for a single phase to two-dimensional point equations for multiphase systems are derived. The theorems are then applied to obtain the vertically averaged balance equations of mass, chemical species, momentum, energy, and entropy. The relation between these equations and their unaveraged predecessors is clearer than when the standard two-step averaging procedure is applied. Furthermore, constitutive relations are more easily hypothesized for the current system of equations than for previously derived forms. (Author's abstract)
W83-02930

PRELIMINARY STUDIES OF THE RESERVOIR CAPACITY AND THE GENERATING POTENTIAL OF THE BACA GEOTHERMAL FIELD, NEW MEXICO,
California Univ., Berkeley. Lawrence Berkeley Lab.
G. S. Bodvarsson, S. Vonder Haar, M. Wilt, and C. F. Tsang.
Water Resources Research, Vol 18, No 6, p 1713-1723, December, 1982. 11 Fig, 2 Tab, 21 Ref.

Descriptors: *Geothermal resources, *Transmissivity, *Groundwater reservoirs, Baca Geothermal Field, *New Mexico, Permeability.

The Baca Geothermal field at Valles Caldera, New Mexico, may not be able to supply enough steam to operate a 50 MW powerplant for 30 years, according to simulation studies using published data. Although the estimated reservoir reserves of 1 trillion kg of hot fluid over a 40 sq km area were considered adequate, the low transmissivity would cause localized boiling and rapid pressure decline during exploitation. Transmissivity values of the Baca reservoir (1830 md m) are an order of magnitude lower than in successfully developed fields. The numerical simulator SHAFT79 was used to estimate longevity. In none of the 5 cases (1 closed reservoir, 1 infinite reservoir, and 3 injection) could the flow rate be maintained longer than 15 years. For variable production rates a reservoir life of 25-49 years is indicated. (Cassar-FRC)
W83-02935

GEOTHERMAL RESOURCES IN THE BANBURY HOT SPRINGS AREA, TWIN FALLS COUNTY, IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
R. E. Lewis, and H. W. Young.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.50. Geological Survey Water-Supply Paper 2186, 1982. 27 p, 13 Fig, 5 Tab, 21 Ref.

Descriptors: *Geothermal studies, *Thermal springs, *Water temperature, *Water analysis, Water use, Wells, Water level fluctuations, Stable isotopes, Radioisotopes, Heat balance, *Idaho, Banbury Hot Springs.

Thermal water (30.0 to 72.0 degrees Celsius) is produced from 26 wells and 2 springs in the vicinity of Banbury Hot Springs near Buhl, Idaho. Thermal water is used for space heating of private residences, catfish and tropical fish production, greenhouse operation, swimming pools, and therapeutic baths. In 1979, 10,300 acre-feet of thermal water was utilized; heat discharged convectively from the geothermal water was utilized; heat discharged convectively from the geothermal system was about 1.09x10 to the 7th power calories per second. Decline in artesian head and discharge apparent in recorder charts from two wells may represent seasonal fluctuations or may reflect aquifer response to development of the resource. Thermal waters sampled are sodium bicarbonate in character and slightly alkaline. Mixing of a hot (72 degrees Celsius) water with local, cooler ground water can be shown from various relations between stable isotopes, chloride, and enthalpy. On the basis of concentration of tritium, age of the waters sampled is at least 100 years and perhaps more than 1,000 years. One water (33 degrees Celsius) may be as young as 29 years. On the basis of silica, sodium-potassium-calcium, and sulfate-water geothermometers, best estimate of the maximum reservoir temperature for the thermal waters is between 70 and 100 degrees Celsius. (USGS)
W83-02972

GEOLOGIC AND WELL-CONSTRUCTION DATA FOR THE H-7 BOREHOLE COMPLEX NEAR THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Fenix and Scisson, Inc., Tulsa, OK.
For primary bibliographic entry see Field 4B.
W83-02977

AQUIFER TEST RESULTS, GREEN SWAMP AREA, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
C. H. Tibbals, and H. F. Grubb.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-117903, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-35, 1982. 29 p, 17 Fig, 2 Tab, 13 Ref.

Descriptors: *Aquifer testing, *Transmissivity, *Storage coefficient, *Leakage, Artesian aquifer, Limestone, Confining beds, *Hydraulic diffusivity, *Florida, Green Swamp area, Floridan aquifer.

An aquifer test conducted in the Green Swamp area December 15-16, 1975 was designed to stress the uppermost part of the Floridan aquifer so that the leakage characteristics of the overlying confin-

ing bed could be determined. A well tapping the upper part of the Floridan aquifer was pumped at a rate of about 1,040 gallons per minute for 35 hours; drawdown was measured in the Floridan aquifer and in two horizons in the confining bed. Analysis of the data indicates that the transmissivity of the uppper 160 feet of the Floridan is 13,000 square feet per day, the storage coefficient is about 0.0002.5, and the overlying confining bed leakance coefficient is about 0.02 to 0.025 per day. The vertical hydraulic diffusivity of the confining bed ranged from 610 square feet per day to 16,000 square feet per day. Results of the test indicate that, in the area of the test site, a Floridan aquifer well field would induce additional recharge to the Floridan. As a result of that increased recharge, water levels in the surficial aquifer would tend to stand lower, runoff from the area would tend to be less, and, perhaps, evapotranspiration would be less than normal.(USGS)
W83-02980

GEOLOGY AND GROUND-WATER RESOURCES OF OSWEGO COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
T. S. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124651, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-60, 1982. 37 p, 28 Fig, 1 Tab, 44 Ref.

Descriptors: *Groundwater, *Glacial aquifers, *Geology, *Aquifer characteristics, Glacial drift, Fracture permeability, Wells, *New York, Oswego County.

Unconsolidated deposits of Pleistocene and Holocene age form a nearly continuous cover in Oswego County. Pleistocene deposits consist of lodgment and ablation tills, outwash, kame, beach and wave-delta sand and gravel, and lacustrine sand, silt, and clay. Holocene deposits consist of peat and muck deposited in wetlands, and alluvial silt, sand, and gravel deposited in stream valleys. Unconsolidated deposits contain sufficient water for domestic and small farm needs except in areas mantled by silt and clay. Sand and gravel deposits are the best source of large quantities of water. Aquifers in glacial outwash are common in the eastern Tug Hill region, whereas kame, eskerkame, and beach aquifers predominate in the eastern and central regions. The principal sand and gravel aquifer, known as the Lacona-Williamstown aquifer, is 20 miles long, 0.5 to 3 miles wide, and 10 to 85 feet thick. Wells tapping the aquifer yield from 220 to 800 gallons per minute. Fracturing, rather than rock type, is the controlling factor in the water-producing capacity of bedrock. Bedrock near or at land surface provides adequate supplies for domestic and farm needs. Shallow wells in bedrock have water of fair to good quality, but material content increases with depth. (USGS)
W83-02987

GROUND-WATER RESOURCES OF THE ARCADIA-MINDEN AREA, LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
G. N. Ryals.
Louisiana Department of Public Works Water Resources Technical Report 28, 1982. 35 p, 4 Fig, 3 Plates, 10 Tab, 18 Ref.

Descriptors: *Groundwater, *Groundwater availability, *Aquifer characteristics, *Water yield, Aquifer testing, Geohydrologic units, Wells, Drawdown, Water table, Water level, Water supply, Water use, Water quality, Chemical analysis, Ion exchange, Hydrologic data, *Louisiana, Arcadia-Minden area.

The Sparta Sand aquifer of Eocene age yields 97% of the water used in the Arcadia-Minden area of north-central Louisiana along Interstate Highway 20 and U.S. Highway 80. Pumpage from the Sparta aquifer in 1980 was 6.2 million gallons per day. The potentiometric surface, which about 150 to 400 feet above the principal Sparta sands, is declining at the rate of 1/2 to 4 feet per year. As hydraulic conditions change from artesian to water table, the rate of decline will decrease. Generally, water from the Sparta aquifer meets the U.S. Environmental Protection Agency drinking-water standards. The Wilcox Group of Paleocene-Eocene age contains freshwater only in the southwestern part of the area. Pumpage was only 0.2 million gallons per day in 1980. Freshwater in the Wilcox meets the U.S. Environmental Protection Agency drinking-water standards except at some sites where iron concentrations are excessive. The terrace aquifer, which occurs in the western part of the study area, can be used to supplement supplies from the Sparta and Wilcox aquifers for small domestic wells. The Arcadia, Bistineau, Gibsland, Minden, and Vacherie salt domes are disturbances caused by the local intrusion of salt. The vertical salt movements have disrupted the base of freshwater in the vicinity of the domes; however, the area affected is only about 4 square miles at each dome. (USGS)
W83-02991

HYDROLOGY OF THE SURFICIAL AQUIFER IN THE FLOYD RIVER BASIN, IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
K. D. Wahl, M. J. Meyer, and R. A. Karsten.
Available from Iowa Geological Survey, 123 N. Capitol St., Iowa City, Iowa 52242. Iowa Geological Survey Water-Supply Bulletin No 12, 1982. 53 p, 18 Fig, 5 Plates, 17 Tab, 36 Ref.

Descriptors: *Surface-groundwater relations, *Geohydrology, *Water quality, *Water use, Streamflow, Flow duration, Low flow, Aquifers, Groundwater movement, Groundwater recharge, *Iowa, Floyd River basin.

The Floyd River basin drains 960 square miles in northwest Iowa. Most of the basin is underlain by glacial drift of Pleistocene age which is in turn underlain by rocks of Cretaceous age. The major stream valleys and adjacent terraces commonly are underlain by alluvial sand-and-gravel beds. These sand-and-gravel beds and older sand-and-gravel beds in the glacial drift comprise the surficial aquifer. The surficial aquifer is recharged by local precipitation and discharges into the Floyd River drainage system. Water use in the basin is largely for public supply and rural-domestic or rural livestock use. The water is of suitable chemical for all uses, although it is hard and has large concentrations of sulfate in some areas. (USGS)
W83-02993

GROUNDWATER RESOURCES IN THE JUAREZ-EL PASO REGION (DE AGUAS SUBTERRANEAS EN LA REGION DE JUAREZ-EL PASO),
Escuela Superior de Agricultura Hermanos Escobar, Chihuahua (Mexico). Area de Manejo de Agua y Suelo.
C. A. Rincon Valdes.
Natural Resources Journal, Vol 22, No 4, p 939-941, October, 1982. English summary.

Descriptors: *Groundwater basins, *Geohydrology, *Groundwater management, Groundwater recharge, Groundwater depletion, Water allocation, Water demand, Water use, El Paso, Texas, Juarez, *Mexico.

The Juarez-El Paso Valley, which encompases 52,839 hectares of irrigable land, runs along the Rio Grande on the U.S.-Mexico border. Although agricultural development in this region is possible only through irrigation, the economies of both Juarez and El Paso depend largely on agriculture and cattle. The primary sources of groundwater in the region are the Hueco Bolson, the Mesilla Bolson, and the Rio Grande alluvium. The groundwater of the three basins is hydrologically connected, flowing from areas of recharge to areas of drainage. The Hueco Basin is recharged at a rate of about 7 million cubic meters per year, while depletion occurs at a rate of about 18 million cubic meters per year. Recharge of the Mesilla Basin is estimated at about 22 million cubic meters annually, while its rate of depletion is about 14 million cubic meters per year. The Rio Grande alluvium is recharged at a rate of about 98 million cubic meters per year, while depletion is about 29 million cubic meters annually. Pump wells account for most of the extraction of water resources both of the Rio Grande alluvium and of the Hueco Basin. The Juarez Water and Drainage Board reports that the volume of water pumped in Juarez tripled between 1968 and 1981. Official agencies in Mexico carefully control municipal and agricultural use of water, levying fines and/or reducing water supplies for prescribed periods of time against users who waste water. The states of Chihuahua and Texas should work together to protect the water resources of the area and to promote conservation, since their groundwater supplies are interconnected. (Carroll-FRC)
W83-03020

GEOTHERMAL RESOURCES IN THE NORTHWESTERN BORDER (RECURSOS GEOTHERMICOS EN LA FRONTERA NOROCCIDENTAL),
J. Eibenschutz.
Natural Resources Journal, Vol 22, No 4, p 991-997, October, 1982. English summary.

Descriptors: *Geothermal power, *Electric power production, *Resources development, Natural resources, Electric powerplants, Water demand, Water use, *Mexico, Valley of Mexicali.

The Valley of Mexicali, located in a rift zone, has been estimated to contain a geothermal production potential of between 850 and 1,700 megawatts of electric power capacity using current technology. Cerro Prieto, one of the areas of the valley, already has an operating capacity of 180 megawatts. Two more plants, with capacities of 220 megawatts each, are being constructed for operation in 1983 and 1984, respectively. In addition to the electricity producing application of the geothermal fluids, a process for the production of potassium chloride has been developed, which involves evaporating the brine in a solar pond, followed by further crystallization of the residues. Some processes are also being developed for the utilization of the hot water in such applications as hydroponics and aquaculture. Collaboration with bordering agencies involved in geothermal energy has resulted in beneficial exchange of technical information. Agreements have been signed with San Diego Gas and Electric Company and with Southern California Edison for the export of a total capacity of 275 megawatts. (Author's abstract)
W83-03021

USE OF GEOLOGIC AND WATER YIELD DATA FROM GROUND WATER BASED COMMUNITY WATER SYSTEMS AS A GUIDE FOR GROUND WATER PLANNING AND MANAGEMENT,
North Carolina State Univ. at Raleigh. Dept. of Marine, Earth and Atmospheric Sciences.
For primary bibliographic entry see Field 4B.
W83-03046

MODELING DIRECT RECHARGE OF SURFICIAL AQUIFERS,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
B. D. Knoch, D. C. Slack, and C. L. Larson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208611, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Minnesota, St. Paul, April 1983. 105 p, 30 Fig, 8 Tab, 137 Ref, 1 Append. OWRT A-043-MINN(1), 14-34-0001-0125.

Descriptors: *Groundwater, *Groundwater recharge, *Recharge modeling, Soil moisture, Infiltration, Evapotranspiration, Model studies, *Simulation analysis, *Computer models, Water table levels, *Minnesota Andover, Frozen soil.

A one-dimensional, physically-based computer model was developed for predicting direct groundwater recharge. The model was verified using three years of data from an instrumented site in

east central Minnesota. Although the processes of infiltration and redistribution during frozen soil periods were not modeled, the model is capable of operating during both frozen and non-frozen soil periods. The model includes submodels for evapotranspiration, soil water extraction, snowmelt, surface depressional storage, infiltration and redistribution. The model predicts water table level and soil moisture. Water extraction may also be modeled. The model predicted both water table levels and soil moisture with reasonable accuracy over the three year period modeled.
W83-03101

2G. Water In Soils

MIDSEASON SOIL WATER RECHARGE FOR CORN IN THE NORTHWESTERN CORN BELT,
Michigan Agricultural Experiment Station, East Lansing.
B. S. Johnson, G. R. Blake, and W. W. Nelson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-205351. Water Resources Research Center Completion Report, Univ. of Minnesota, St. Paul, March 1983. 20 p, 6 Fig, 3 Tab, 12 Ref. OWRT A-042-MINN(1).

Descriptors: *Soil water storage, *Soil water recharge, *Subsurface moisture, Irrigation, Water conservation, *Corn, Northern Great Plains, *Minnesota, *Clay loam, *Crop yield.

Field experiments were conducted from 1979-82 on a Nicollet clay loam soil to determine the effects of midseason soil water recharge on corn production. Six treatments consisting of timing and amount variables of supplemental water additions were studied. Extensive soil water depletion to 90 cm occured in both 1980 and 81, the water table could not be detected within 200 cm of the soil surface in 1981. Despite these diverse conditions, positive significant grain yield resulting from the midseason application of 7.6 cm of water exceeded grain yield with natural precipitation by 1808, 2730, and 1947 kg/ha in 1979, 80, and 81, respectively. Grain production was enhanced as effectively by single-midseason applications of 7.6 cm of water as by 'optimum irrigation' (application of 3.8 cm at 50% depletion of plant-available water to a soil depth of 90 cm). In the presence of a receding water table (1980), 90% of the grain yield variability and 92% of the variability in total dry matter production (TDMP) was accounted for by the amount of supplemental water added and early-season water table depth. Response to the addition of supplemental water diminished with decreasing early-season water table depth.
W83-02890

TEST OF AN EQUATION FOR EVAPORATION FROM BARE SOIL,
British Columbia Univ., Vancouver. Dept. of Soil Science.
M. D. Novak, and T. A. Black.
Water Resources Research, Vol 18, No 6, p 1735-1737, December, 1982. 3 Fig, 11 Ref.

Descriptors: *Soil water, *Evaporation, *Advection, Idso equations, Priestley-Taylor equations, Agassiz, *British Columbia.

An empirical equation developed by Idso et al. (Water Resources Research, Vol 15, p 487-488, 1979) at Phoenix, Arizona, to calculate daily average evaporation rates during all three drying stages of a bare soil was tested using measurements made at Agassiz, British Columbia, and is discussed on the basis of available evaporation theory. The results show that these authors' expression for potential evaporation rate did not apply at Agassiz due to differences in the advection regimes at the two locations. The Agassiz potential evaporation rate data was well represented by the Priestley-Taylor equation with alpha = 1.27 + or - 0.1. It was concluded that the Idso et al. equation for potential evaporation has no greater generality than the Priestley-Taylor or other such semiempirical approaches. The concept of expressing the stage III rate as proportional to the expression for potential evaporation rate worked marginally well at a cultipacked site and quite well at a disc-harrowed site. It was concluded that for soils with stage III rates much greater than 50% of potential evaporation rate, more complete procedures are necessary for calculating evaporation rates during extended drying periods. (Author's abstract)
W83-02929

ON SUBSURFACE STORMFLOW: PREDICTIONS WITH SIMPLE KINEMATIC THEORY FOR SATURATED AND UNSATURATED FLOWS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
K. Beven.
Water Resources Research, Vol 18, No 6, p 1627-1633, December, 1982. 5 Fig, 1 Tab, 26 Ref.

Descriptors: *Hydrographs, *Subsurface flow, *Soil water, Rainfall, Model studies, *Storm water, East Twin Brook Catchment, *United Kingdom, Slopes, Unsaturated flow, Saturated flow.

Analytical solutions for partial and full equilibrium hydrographs of subsurface stormflow are presented for permeable soils on steep slopes. Solutions are based on kinematic approximations in both unsaturated and saturated zones. The analysis is restricted to constant rainfall intensities and simply defined functional relationships of saturated hydraulic conductivity, porosity, and soil moisture characteristics with depth in the soil profile. Solutions for rising, falling, and partial equilibrium hydrographs are given. Application of the model to data collected by Weyman (1970-1973) on a slope segment of the East Twin Brook catchment, Mendip Hills, United Kingdom, showed agreement between observed and calculated hydrographs. (Cassar-FRC)
W83-02931

TIME-DEPENDENT, LINEARIZED TWO-DIMENSIONAL INFILTRATION AND EVAPORATION FROM NONUNIFORM AND NON-PERIODIC STRIP SOURCES,
Karadeniz Teknik Univ., Trabzon (Turkey). Dept. of Civil Engineering.
V. Batu.
Water Resources Research, Vol 18, No 6, p 1725-1733, December, 1982. 10 Fig, 20 Ref.

Descriptors: *Infiltration, *Irrigation design, *Evaporation, Sprinkler irrigation, Furrow irrigation, Porous media, Unsaturated flow, Soil water, Model studies, Hydraulic conductivity, Model studies.

Using a linearized equation describing unsaturated homogenous and isotropic porous media flow, a general, two-dimensional, time-dependent mathematical model is presented for infiltration and/or infiltration-evaporation from nonuniform and non-periodic strip sources located at the soil surface. The analysis is based on an exponential relationship between the unsaturated hydraulic conductivity and the soil water pressure head and also assumes a constant value for the derivative of unsaturated hydraulic conductivity with respect to water content. In the mathematical analysis, Laplace transform and Fourier analysis techniques are used simultaneously, and a general equation in an integral form for the distribution of matric flux potential has been obtained. The result of Warrick and Lomen (1976) for a single strip source is shown to be a special case of this general model. The solution for infiltration from two strip sources is presented as another special case. Also, a third special case is presented for infiltration from two strip sources and evaporation from another strip located in the middle part. The horizontal and vertical flux components for these cases are presented. All results are expressed in integral forms and calculated with a computer using a numerical integration method. The solutions predict the matric flux potential and flux components as functions of space and time. Examples that illustrate the applicability of some of the solutions are presented. These solutions are of interest in the design of both sprinkler and furrow irrigation systems. The results may also be used for different purposes in civil and agricultural engineering applications. (Author's abstract)
W83-02938

SPATIAL VARIABILITY OF SURFACE TEMPERATURE ALONG TWO TRANSECTS OF A BARE SOIL,
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. Vauclin, S. R. Vieira, R. Bernard, and J. L. Hatfield.
Water Resources Research, Vol 18, No 6, p 1677-1686, December, 1982. 13 Fig, 4 Tab, 27 Ref.

Descriptors: *Sampling, *Soil temperature, *Soil water, *Soil surfaces, Temperature, Spatial distribution, Variability, Davis, *California, Sprinkler irrigation, Irrigation, Infrared thermometers, Statistical analysis, Soil physics, Correlation analysis, Remote sensing.

The spatial variability of surface temperature on bare soil was measured at 1-2 p.m. on 3 consecutive days after sprinkler irrigation in a 1 ha field at Davis, California. Temperatures were measured at every meter along two transects (60 and 100 m long) with two infrared thermometers differing only in their field of view. Soil samples were collected on the third day to determine the water content in the 5 cm upper layer. Semivariograms and auto-correlation functions were determined and their measurements found to be correlated over space. A first-order autoregressive process with a white noise described the spatial structure of all data sets. Sampling of surface temperature and surface wetness along transects or over a grid at regular intervals rather than random locations gives more reliable ground truth data to use with remote sensing. (Cassar-FRC)
W83-02940

WATER DIFFUSIVITY OF A FIELD SOIL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
B. E. Clothier, and I. White.
Soil Science Society of America Journal, Vol 46, No 1, p 155-158, January/February, 1982. 3 Fig, 8 Ref.

Descriptors: *Porosity, *Soil physical properties, *Infiltration, Soil water, Diffusivity, Sand, Bungendore sand, Absorption, Pore size, Soil porosity, *Biopores.

The wetting diffusivity of a Bungendore fine sand in the undisturbed state and repacked in the laboratory, were compared. The repacked sand had a near-rectangular profile of absorption, showing that the diffusivity is strongly dependent on soil water content. However, the undisturbed sand had a flatter absorption profile and a diffusivity that did not vary as strongly with soil water content. Thin section micromorphology showed that the repacking had reduced the continuity of biogenic mesopores, 0.1 to 1 mm in diameter, present in the undisturbed soil. These are formed by plant roots, fungal hyphae, or soil microfauna. Although repacking the soil did not significantly change the total porosity of the soil, the pore size distribution was shifted toward fewer, larger pores. (Cassar-FRC)
W83-02995

WATER ADSORPTION AND SWELLING OF CLAY MINERALS IN SOIL SYSTEMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
J. C Parker, D. F. Amos, and L. W. Zelazny.
Soil Science Society of America Journal, Vol 46, No 3, p 450-456, May/June, 1982. 5 Fig, 3 Tab, 26 Ref.

Descriptors: *Soil absorption capacity, *Porosity, *Compaction, Soil physical properties, Adsorption, *Clays, Soil compaction, Soil water, Soil porosity, Expansion, Wetting.

The effects of compaction and cyclic wetting and drying were evaluated for two soils: Poplimento

(9% montmorillonite and 11% vermiculite) and Iredell (48% montmorillonite and 15% vermiculite). Soil samples were left undisturbed or compacted at three soil moistures: optimum, below optimum, and above optimum. In Poplimento samples initial wetting produced small volume changes, suggesting that changes in soil moisture with increasing moisture during compaction counteracted normal moisture-dependent differences by reducing expansion space into large voids or by increasing expansion from entrapped air pressures, strain relaxation, and differential strain. Compacted Iredell samples showed an inverse relationship between moisture at compaction and swelling during initial wetting. Expansion during the second wetting followed the order: Poplimento--undisturbed = optimum = above optimum > below optimum; and Iredel--optimum > undisturbed = above optimum > below optimum. Values for swelling attributable to entrapped air pressures did not reflect the inverse relationship between entrapped air pressures and probable pore size suggested by the Laplace equation. The discrepancy may be explained by rate of water uptake and resistance to expansion. Intracrystalline swelling accounted for < 10% of total expansion in samples. Discrepancies between swelling and expansion were related to crystal strain relaxation and differential stress between adjacent crystals or aggregates. This effect increased with increasing compaction moisture for Poplimento and was unaffected by treatment for Iredell. (Cassar-FRC)
W83-02996

ABSORPTION OF WATER BY SOIL: THE EFFECT OF A SURFACE CRUST,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
D. E. Smiles, J. H. Knight, and K. M. Perroux.
Soil Science Society of America Journal, Vol 46, No 3, p 476-481, May/June, 1982. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Infiltration, *Soil physics, *Soil surfaces, Absorption, Soil water, Soil absorption capacity, Impervious membranes, Membranes, Surface sealing, Permeability.

The one-dimensional absorption of water by a uniform soil through a relatively impermeable surface crust was analyzed by conventional soil physics theory. This permitted calculation of the changing water potential at the soil-crust interface, the water content profiles, and the cumulative volume of water absorbed. This approach was used for situations where the conductance of the crust is constant. Experimental data using columns of fine sand confirmed the theory and demonstrated that the space- and time-like variables of Ahuja and Swartzendruber (1973) and the two variables, cumulative volume of water absorbed by the soil and the reduced flux at the surface, provide a useful set of reduced coordinates for describing adsorption through a membrane with a constant conductance. (Cassar-FRC)
W83-02997

STRATIGRAPHY AND WATER TABLE RELATIONSHIPS OF UPLAND LOESS-DERIVED SOILS IN SOUTH-CENTRAL IOWA,
Iowa State Univ., Ames. Dept. of Agronomy.
T. L. Coleman, and T. E. Fenton.
Soil Science Society of America Journal, Vol 46, No 1, p 82-87, January/February, 1982. 8 Fig, 4 Tab, 14 Ref.

Descriptors: *Water table, *Geomorphology, *Stratigraphy, *Iowa, Loess, Paleosols, Drainage, Soil water table, Yarmouth-Sangamon surface, Groundwater level, Seasonal variation.

The effects of stratigraphy and landscape position on water table levels in loess soils were studied in southcentral Iowa. Here the loess-covered primary divides reach their maximum width and minimum depth. The buried geomorphic surface (Yarmouth-Sangamon surface) is at its minimum depth with respect to the soil surface. The water table, also minimum in this region, fluctuates during the year. Monthly measurements of depth to water table were made along two geographically linear traverses on primary divides during 1978 and 1979. The depth of loess on the flat and sloping primary divides decreased with distance from the major loess source area, the Missouri River Valley. Natural drainage became poorer as the loess layer became thinner. On the flat and sloping divides the highest water tables were seen in the spring, and the lowest during fall. Water table depths were less cyclic in shallower loess layers. Negative correlations were found between depth to water table and capillary porosity of the B and C horizons, total porosity of the B horizon, and rainfall. Positive correlations were found between depth to water table and total porosity of the C horizon and temperature. (Cassar-FRC)
W83-02998

SOIL HYDRAULIC PROPERTIES AS STOCHASTIC PROCESSES: II. ERRORS OF ESTIMATES IN A HETEROGENEOUS FIELD,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
D. Russo, and E. Bresler.
Soil Science Society of America Journal, Vol 46, No 1, p 20-26, January/February, 1982. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Stochastic process, *Soil properties, *Error analysis, Hydraulic properties, *Spatial distribution, *Kriging technique, Variation coefficient, Statistical analysis, Hydraulic conductivity.

Results of integral scales and coefficient of variation (C.V.) from Part I of this study D. Russo and E. Bresler, (Soil Science Society of Americal Journal, Vol 45, p 682-687, 1981) are applied to evaluate errors in estimating average values of several hydraulic properties. Based on the Ergodic Hypothesis and on standard statistical theory, an equation is derived to calculate the total field area and number of measurements needed to estimate (for a prescribed error) ensemble averages of a given hydraulic property. For a 0.8 ha field with 90 measurements performed to estimate mean values of various hydraulic properties, the errors are in the range between 7 and 46%. Various combinations of number of intergral scales (I) and number of measurements (N) are used to estimate mean values of a given hydraulic property with a given error. An 'optimal' I-N combination is derived. With this approach, 4 to 156 integral scales and 2 to 190 measurements are needed to estimate man values of the various hydraulic properties with 20% error. The kriging technique and fictitious point method are used to evaluate number and locations of additional observation points needed to estimate mean value of the saturated hydraulic conductivity (Ks) over a finite field with a given accuracy. To obtain the C.V. of Ks of 2.5% nine additional points are required. (Author's abstract)
W83-02999

TEMPERATURE DEPENDENCE OF UNSATURATED HYDRAULIC CONDUCTIVITY OF TWO SOILS,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. Constantz.
Soil Science Society of America Journal, Vol 46, No 3, p 466-470, May/June, 1982. 4 Fig, 5 Tab, 14 Ref.

Descriptors: *Temperature effects, *Hydraulic conductivity, *Soil properties, Permeability, Soil water potential, Viscosity, Surface tension, Hanford sandy loam, Oakley sand.

Steady state evaporative flux experiments were run at uniform soil temperatures of 2, 25, and 45C for packed columns of Hanford sandy loam and Oakley sand. Soil matric potentials were measured, unsaturated hydraulic conductivities were calculated, and water retention characteristics (to -100 kPa) were determined. Results obtained from this study were at least an order of magnitude different from those obtained from an equation that relates unsaturated hydraulic conductivity to the intrinsic permeability, the relative permeability, and the viscosity of water. It considers that viscosity is the only parameter which changes with temperature. Results obtained from the soil columns show a much greater temperature dependence in the unsaturated conductivity than predicted by the equation. Results suggest that the relative permeability may be a function of temperature and water content. (Cassar-FRC)
W83-03000

HYDRODYNAMIC DISPERSION DURING UNSTEADY, UNSATURATED WATER FLOW IN A CLAY SOIL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
D. E. Smiles, and B. N. Gardiner.
Soil Science Society of America Journal, Vol 46, No 1, p 9-14, January/February, 1982. 2 Fig, 17 Ref.

Descriptors: Hydrodynamics, *Solute transport, *Soil water, *Clays, *Calcium chloride, Fate of pollutants, Unsteady flow, Unsaturated flow, Dissolved solids, Saline water, *Dispersion.

An analytical and conceptual framework is described for exploring hydrodynamic dispersion and reaction in a chemically reactive clay soil during unsaturated, unsteady flow. A 0.1 M calcium chloride solution was applied to a calcium-saturated clay soil with an initially low water content and solution salt concentration. Both parameters preserved similarity in terms of distance divided by the square root of time. The salt front did not coincide with the piston front for the water that might exist if invading water completely displaces the water originally present. This effect was attributed to an immobile water layer on the clay surface about 9 angstroms thick, which was inaccessible to the anion. There appeared to be no restriction on the entry of calcium chloride into the soil when compared with water. A reasonable prediction of solution salt concentration profile was obtained using material coordinates and a constant dispersion coefficient if the inaccesible water layer was considered. (Cassar-FRC)
W83-03001

BACTERIAL UTILIZATION OF SIMPLE ALCOHOLS AND THEIR INFLUENCE ON SATURATED HYDRAULIC CONDUCTIVITY,
Iowa State Univ., Ames. Dept. of Agronomy.
W. T. Frankenberger, Jr, and F. R. Troeh.
Soil Science Society of America Journal, Vol 46, No 3, p 535-538, May/June, 1982. 1 Fig, 5 Tab, 14 Ref.

Descriptors: *Hydraulic conductivity, *Porosity, *Bacteria, Organic compounds, *Methanol, *Propanol, Soil porosity, Microorganisms, Enzymes, Phosphatase, Leaching, Soil physical properties.

Saturated hydraulic conductivities of two cropland soils were significantly reduced by the presence of methanol or n-propanol. Laboratory soil columns containing a Nicollet loam or a Tama silty clay loam were leached for 2000 hours with distilled water, 500 ppm methanol in water, or 500 ppm n-propanol in water. The saturated hydraulic conductivity decreased logarithmically with time until constant values were obtained at about 1500 hours. The mean hydraulic conductivities (cm per hour) after 1500 hours were: Tama soil-distilled water, 2.65; methanol, 0.09; and n-propanol, 0.40; Nicollet soil-distilled water, 4.02; methanol, 0.21; and n-propanol, 0.56. The initial decreases in saturated hydraulic conductivities were a result of structural breakdown of the soil aggregates and expansion of clays; the later decreases were probably related to microbial action in which soil pores became clogged with biological matter. pH values of effluents after 2000 hours leaching were lower for all 3 treatments, with distilled water showing the greatest change. Phosphatase activity was greatest in the oxidized zone (surface) of the columns in decreasing order: methanol > n-propanol > distilled water. As phosphatase activity increased, saturated hydraulic conductivity decreased. (Cassar-FRC)
W83-03014

INFILTRATION AS AFFECTED BY LONG-TERM USE OF SODIC-SALINE WATER FOR IRRIGATION,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
For primary bibliographic entry see Field 3C.
W83-03016

THE EFFECT OF TURFGRASS THATCH ON WATER INFILTRATION RATES,
Minnesota Univ., St. Paul. Dept. of Horticultural Science and Landscape Architecture.
For primary bibliographic entry see Field 4A.
W83-03023

SOIL PORE STRUCTURAL STABILITY AND IRRIGATION WATER QUALITY: III. EVALUATION OF SOIL STABILITY AND CROP YIELD IN RELATION TO SALINITY AND SODICITY,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science and Agrometeorology.
A. Cass, and M. E. Sumner.
Soil Science Society of America Journal, Vol 46, No 3, p 513-517, May/June, 1982. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Soil stability, *Irrigation water, *Saline water, Water pollution effects, Sodium stability model, Soil structure, Crop yield, Water quality, Soil porosity, Porosity, Soil properties, Hydraulic conductivity.

The relationship between irrigation water quality and soil structural stability is described by a model. A family of threshold concentration curves is determined empirically for each soil. After the variation in composition and concentration of soil water is estimated as a function of rainfall, evapotranspiration, and soil drainage, the quantitative soil stability index is obtained by intersection of the sodium stability curve with the irrigation water-soil solution rectangle. This evaluation is based on a stability index from zero (irrigation water will cause breakdown in soil pore structure) to unity (no structural deterioration likely). Crop response (yield index) to salinity can be evaluated in a similar manner. Both soil stability index and yield index were quantitatively determined for 4 irrigation waters (EC 7.7-191.4 mS per m), 4 soil waters (EC 55-2900 mS per m), 4 soils, 3 crops. (Cassar-FRC)
W83-03025

SOIL PORE STRUCTURAL STABILITY AND IRRIGATION WATER QUALITY: II. SODIUM STABILITY DATA,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science and Agrometeorology.
A. Cass, and M. E. Sumner.
Soil Science Society of America Journal, Vol 46, No 3, p 507-512, May/June, 1982. 4 Fig, 4 Tab, 30 Ref.

Descriptors: *Soil stability, *Irrigation water, *Saline water, Water pollution effects, Soil structure, Sodium stability model, Soil porosity, Porosity, Clays, Hydraulic conductivity, Soil properties, Water quality, *South Africa.

The effect of mixed Na/Ca solutions on hydraulic conductivity of 20 soils from the South African arid region was studied at fixed sodium absorption values and cation concentrations of 1 to 800 meq per liter. Water uptake (macroscopic swelling) of extracted soil clays was investigated using the same solutions. Na sensitivity and threshold swelling models were computed. The slope of the Na sensitivity model was related to the smectite content, cation exchange capacity, and specific surface of pedal, nonvertisol soils. It was also related to swelling by a log-linear relationship. Some vertisols did not obey these relationships because flowbed geometry was altered during swelling, producing higher hydraulic conductivities than expected from the soil properties. Apedal soils with large amounts of smectite were also more stable than expected because of the stabilizing effects of sesquioxides on clay swelling. Soils most stable in the presence of Na/Ca solutions have low specific surface, low cation exchange capacity, and little smectite and/or sufficient sesquioxide to inhibit swelling. (Cassar-FRC)
W83-03026

SOIL PORE STRUCTURAL STABILITY AND IRRIGATION WATER QUALITY: I. EMPIRICAL SODIUM STABILITY MODEL,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science and Agrometeorology.
A. Cass, and M. E. Sumner.
Soil Science Society of America Journal, Vol 46, No 3, p 503-506, May/June, 1982. 7 Fig, 16 Ref.

Descriptors: *Soil stability, *Saline water, *Irrigation water, Soil porosity, Soil structure, Water pollution effects, Clays, Hydraulic conductivity, Sodium stability model, Porosity, Model studies, Soil properties, Water quality.

A relationship, the sodium stability curve, provides a basis for evaluating soil aggregate stability. For each soil it provides a slope (resistance of the soil to hydraulic conductivity reductions in general) and an intercept (sensitivity of soil pore structure to changes in solution concentration and composition). This concept may also be applied to the swelling properties of soils or extracted soil clays (macroscopic swelling in response to a decrease in cation concentration at selected sodium absorption ratios). (Cassar-FRC)
W83-03027

A NUMERICAL STUDY OF RAINDROP IMPACT PHENOMENA: THE RIGID CASE,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 2J.
W83-03029

WATER QUALITY MODELING OF THE EQUUS BEDS AQUIFER IN SOUTH CENTRAL KANSAS,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 5B.
W83-03042

TRANSPORT OF WATER IN FROZEN SOIL: I. EXPERIMENTAL DETERMINATION OF SOIL-WATER DIFFUSIVITY UNDER ISOTHERMAL CONDITIONS,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2C.
W83-03054

MODELING DIRECT RECHARGE OF SURFICIAL AQUIFERS,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W83-03101

SOIL MOISTURE VARIATION PATTERNS OBSERVED IN HAND COUNTY, SOUTH DAKOTA,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
M. Owe, E. B. Jones, and T. J. Schmugge.
Water Resources Bulletin, Vol 18, No 6, p 949-954, December, 1982. 3 Fig, 5 Tab, 8 Ref.

Descriptors: *Remote sensing, *Soil water, *Sampling, Spatial variation, *South Dakota, Variation coefficient.

Soil moisture data were collected nine times during 1976-78 at a South Dakota test site as part of the ground truth used in an aircraft microwave sensing experiment. Samples were taken over three surface depths (0-2.5, 0-5, and 0-10 cm) at each point. Results, reported as mean field moisture content in each horizon, elucidated the relationship between ground sampling and remote sensing. In areas of varying soil and cover conditions it is advisable to separate data of well-drained sites from poorly-drained sites. The moisture coefficient of variation in a field decreased as the mean field soil moisture increased. The standard deviation was at a maximum in the 15-25% range of moisture conditions. The sample variation decreased as the sample was integrated over a greater depth. It was determined that 10 samples per km was an adequate sampling intensity for characterizing the mean field soil moisture at all three depths along a transect in areas of moderate to good drainage. (Cassar-FRC)
W83-03138

2H. Lakes

CHANGES IN ABUNDANCE AND GROWTH CHARACTERISTICS OF WHITE PERCH FROM THE MOUTH OF THE BAY OF QUINTE,
Ontario Hydro, Toronto. Research Div.
For primary bibliographic entry see Field 6G.
W83-02808

FOOD OF FRESHWATER DRUM IN WESTERN LAKE ERIE,
Fish and Wildlife Service, Sandusky, OH. Biological Station.
M. T. Bur.
Journal of Great Lakes Research, Vol 8, No 4, p 672-675, 1982. 1 Fig, 3 Tab, 13 Ref.

Descriptors: *Fish food organisms, *Invertebrates, *Food habits, *Drum, *Lake Erie, Macroinvertebrates, Benthic fauna, Ecosystems, Cladocerans, Midges, Selectivity, Predation, Zooplankton, Fish diets.

Planktonic cladocerans and larval midges are the primary food organisms of freshwater drum (Aplodinotus grunniens) according to an analysis of drum digestive tracts and samples of macrobenthos in western Lake Erie. Fish less than 1 year old ate mostly cladocerans (87% by volume). Yearlings ate mostly dipterans, while older fish ate both cladocerans and midge larvae. Drum > 250 mm in length also consumed decapods, pelecypods, fish and fish eggs. After the yearling stage, as fish length increased, the proportion of diptera in the diet decreased and the proportion of cladocerans and fish increased. Although oligochaetes and ephippial stages of cladocerans were the most abundant food organisms in the sediments, they constituted < 1% by volume of the drum's diet. The Ivlev index of electivity was positive for diptera at all stations (0.614-0.951) and positive for nematodes at 2 of 9 stations (0.839-0.709). All other benthic food organisms had negative indexes of electivity. (Cassar-FRC)
W83-02810

AN ECONOMIC ANALYSIS OF INTEGRATED FISHERIES MANAGEMENT: THE CASE OF THE LAKE MICHIGAN ALEWIFE AND SALMONID FISHERIES,
Hawaii Univ., Honolulu. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 6B.
W83-02811

VERTICAL DISTRIBUTION OF PROFUNDAL BENTHOS IN LAKE SUPERIOR SEDIMENTS,
Normandale Community Coll., Bloomington, MN.
A. S. Heuschele.
Journal of Great Lakes Research, Vol 8, No 4, p 603-613, 1982. 4 Fig, 3 Tab, 18 Ref.

Descriptors: *Benthic fauna, *Sediments, *Distribution, Invertebrates, Pontoporeia, Oligochaetes, Amphipods, Tubificids, Nematodes, *Lake sediments, Bottom sediments, Profundal sediments, Fate of pollutants, *Lake Superior, Species distribution, Vertical distribution, Mixing.

The density of benthic organisms in box core sediments collected at 10 open lake sites in Lake Superior, July 1978 and June-July 1979, ranged from 782 to 7142 organisms per sq m (average, 3055 per sq m). Water depths varied from 48 to 265 m. Bottom fauna were distributed from the water-sediment interface to a depth of 1.7 cm in firm

glacial till to a depth of 15 cm in soft clay. Oligochaetes and nematodes penetrated further into loose sediments than into compacted sediments. 96% of the benthic organisms were found within the upper 4 cm of sediment, 47% within the upper 0.5 cm (Pontoporeiahoyi, naidids, sphaeriids, copepods, ostracods, and neorhabdocoels) and 49% at the 0.54-4 cm level (nematodes and oligochaetes). 4% were found below 4 cm. For enchytraeids the vertical distribution of oligochaete cocoons was generally similar to that of adults. Cocoons of lumbriculids and tubificids were usually found at higher levels than the adults, possibly as a result of downward migration at the time of sampling. The rapid biological mixing, particularly by Pontoporeia, that takes place in the sediments can effect the movement of pollutants in the sediment and in the food chain. The benthic fauna can keep pollutants available for circulation by resuspension and incorporation into the food chain or remove them by mixing into deeper layers. (Cassar-FRC)
W83-02822

RETENTION OF BENTHIC INVERTEBRATES WITH DIFFERENT SIEVING TECHNIQUES,
Normandale Community Coll., Bloomington, MN.
A. S. Heuschele.
Journal of Great Lakes Research, Vol 8, No 4, p 619-622, 1982. 2 Tab, 9 Ref.

Descriptors: *Benthic fauna, *Sediments, Sampling, *Sieve analysis, Invertebrates, Pontoporeia, Oligochates, Nematodes, *Lake sediments, *Bottom sediments.

Two techniques of washing lake bottom sediment samples produced statistically different numbers of organisms. Sediment in a 250 micron mesh sieve was: (1) washed with a lake water spray from a hose or (2) agitated in a tub of lake water. Method (1) produced 9.8 more nematodes, 8.0 times more enchytraeids, and 11.7 times more naidids than Method (2). Numbers of lumbriculid oligochaetes, Pontoporeia, and fourth instar chironomid larvae were similar for both techniques. Longer sieving times favored the escape of small organisms, especially of the contractile type, producing lower counts. (Cassar-FRC)
W83-02825

TRENDS IN LAKE ONTARIO SURVEILLANCE PARAMETERS, 1974-1980,
Canada Centre for Inland Waters, Burlington (Ontario).
R. E. Kwiatkowski.
Journal of Great Lakes Research, Vol 8, No 4, p 648-659, 1982. 7 Fig, 2 Tab, 52 Ref.

Descriptors: *Water quality, *Monitoring, Great Lakes, *Lake Ontario, Lakes, Phosphorus, Chlorophyll, Organic carbon, Chlorides, Temperature, Sampling, Trend analysis, Statistical analysis, Seasonal variation, *Pollutant identificaiton, Data collections.

Water quality data obtained during 66 cruises and from 95 stations on Lake Ontario between 1974 and 1980 were subjected to trend analysis. There were statistically significant decreases in total phosphorus, chlorophyll a, and particulate organic carbon duuring this period. Seasonally corrected trend-in-time equations were formulated for the 17 zones of interest to the International Joint Commission for temperature, total phosphorus, chlorophyll a, particulate organic carbon, and chlorides. Results indicated that water quality in offshore areas has been more stable than in nearshore areas. Although the equations cannot accurately predict abrupt or major changes in the data, they can be useful in identifying local deviations from historical data in the various zones, and seasons. (Cassar-FRC)
W83-02840

WAVE ACTION AND BOTTOM SHEAR STRESSES IN LAKE ERIE,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
S. W. Kang, Y. P. Sheng, and W. Lick.
Journal of Great Lakes Research, Vol 8, No 3, p 482-494, 1982. 8 Fig, 28 Ref.

Descriptors: *Lakes, *Waves, *Shear stress, Bottom water, Stress, Sedimentation, Wind, Wind waves, *Lake Erie.

The amplitudes and periods of wind-driven, surface gravity waves were calculated by means of the SMB hindcasting method for Lake Erie. Bottom orbital velocities and bottom shear stresses were then calculated using linear wave theory and Kajiura's turbulent oscillating boundary layer analysis. These calculations were made for south-west and north wind directions and a steady wind speed of 40 km/hr. Calcuated bottom shear stresses are related to the textural properties of surficial Lake Erie sediments as determined by Thomas. The bottom shear stresses, especially under prevailing southwest wind conditions, control the textural characteristics of surface sediments in Lake Erie. In particular, wave-induced bottom shear stresses are probably the most important energy source for sediment entrainment. While these analyses provide some useful preliminary information on wave action and bottom stresses in Lake Erie, several aspects of the problem must be considered further. (Baker-FRC)
W83-03073

LARGE LAKES OF THE WORLD,
Ohio State Univ., Columbus. Center for Lake Erie Area Research.
C. E. Herdendorf.
Journal of Great Lakes Research, Vol 8, No 3, p 378-412, 1982. 9 Fig, 8 Tab, 41 Ref.

Descriptors: *Lakes, *Morphometry, Large lakes, Lake Baikal, Water quality, Limnology, Bathymetry, Lake geography, Glaciers, Mapping.

An inventory was undertaken of th distribution, origin, and morphometry of the world's large lakes. Natural lakes, fresh and salt, with a surface area greater than 500 sq km were included. This numbers 253 known lakes. Large lakes occur on all continents, except Antarctica, but nearly half of them are found in North America and most of these lie above the 40th parallel, attesting to the scoring action of continental glaciers. Tectonic belts, such as the Rift Valley of east Africa and the Lake Baikal region of Siberia, are the second most common loci of large lakes. Tabular morphometric data include surface area, drainage basin, elevation, mean and maximum depth, volume, length and breadth and orientation of longest axis. These data show that the large lakes of the world occupy a surface area of 1,456,000 sq km, and they have an estimated volume of 202,000 cu km. Large lakes account for about 90% of the total surface area and volume of water held in all lakes of the world. (Baker-FRC)
W83-03078

LAKE-WIDE SEASONAL CHANGES IN LIMNOLOGICAL CONDITIONS IN LAKE MICHIGAN IN 1976,
Manhattan Coll., Bronx, NY.
C. R. Bartone, and C. L. Schelske.
Journal of Great Lakes Research, Vol 8, No 3, p 413-427, 1982. 10 Fig, 3 Tab, 33 Ref.

Descriptors: *Lakes, *Limnology, *Lake Michigan, Great Lakes, Algae, Phosphorus, Nutrients, Eutrophication, Chlorophyll, Light intensity, Light penetration.

A synthesis is presented of some of the results obtained from a lake-wide sampling that was conducted as part of a research program on eutrophication processes in Lake Michigan. The average water temperature was cooler and average water transparency was greater in the northern lake than in the southern, but with the exception of total phosphorus, average nutrient concentrations did not differ between the northern and southern parts. It was found that physical-chemical characteristics of nearshore and Straits of Mackinac stations differed significantly from open lake stations. Seasonal phytoplankton dynamics in the open lake were related to seasonal and vertical changes in silica and nitrate nitrogen. The spring phytoplankton bloom occurred before the lake was strongly stratified thermally. After thermal stratification was well developed, epilimnetic concentrations of chlorophyll-a decreased, probably due to some combination of nutrient limitation and zooplankton grazing, and maximum chlorophyll-a concentrations were found below the thermocline. Epilimnetic silica concentrations decreased after thermal stratification, and diatoms were replaced in the phytoplankton assemblage by green and blue-green algae in late summer. Total phosphorus averaged only 8 micrograms/liter on a lake-wide basis, and only small but significant reductions in absolute concentration can be expected from phosphorus control programs. Over a period of years, however, these small reductions may be difficult to verify from total phosphorus measurements, which have relatively large sampling errors and variances. (Baker-FRC)
W83-03079

A TEN-YEAR STUDY OF PHYTOPLANKTON BIOMASS AND COMPOSITION IN THE NANTICOKE REGION OF LONG POINT BAY, LAKE ERIE,
Ontario Ministry of the Environment, Rexdale. Limnology and Toxicity Section.
G. J. Hopkins, and C. Lea.
Journal of Great Lakes Research, Vol 8, No 3, p 428-438, 1982. 5 Fig, 5 Tab, 18 Ref.

Descriptors: *Lakes, *Phytoplankton, Great Lakes, *Lake Erie, Biomass, Long Point Bay, Limnology, Temperature effects, Water quality, Algal growth, Taxonomy.

Changes in abundance, taxonomic composition, and the seasonal succession of phytoplankton have been evaluated at seven stations in the vicinity of Nanticoke, east Long Point Bay, Lake Erie, from 1969 to 1978. Quantitative measurements of phytoplankton were recorded as Areal Standard Units per milliliter. The 10-year mean value was 374 A.S.U. per mL. Annual means over the 10 year period varied from a low of 224 ASU per mL in 1969 to 606 in 1978. Seasonal succession patterns and biomass levels showed fluctuation expressing unimodal, biomodal, and even trimodal peaks from station to station and year to year. A total of 240 taxa were recorded during the study, 35 of which were present during all years. Temperature data collected at the same stations suggested that water was warmed during some years, but followed very closely a normal seasonal curve ranging from 5C in April to 22C in August. No direct or inverse relationship to years in which one or the other parameter deviated from the normal pattern was noted in phytoplankton population. Due to the similarity of the algal community in its year-to-year seasonal development and taxonomic composition, the ten years of data presented should provide a sound data base for future comparisons off nearshore phytoplankton in Lake Erie. (Baker-FRC)
W83-03080

TEN ECOSYSTEM APPROACHES TO THE PLANNING AND MANAGEMENT OF THE GREAT LAKES,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 6A.
W83-03082

SORPTION AND SEDIMENTATION OF ZN AND CD BY SESTON IN SOUTHERN LAKE MICHIGAN,
Argonne National Lab., IL.
For primary bibliographic entry see Field 5B.
W83-03083

SOLUBLE REACTIVE PHOSPHORUS MEASUREMENTS IN LAKE MICHIGAN: FILTRATION ARTIFACTS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5A.
W83-03084

DATA FILTERING FOR LARGE AREA ANALYSIS-AN EXAMPLE FROM THE CANADIAN NEARSHORE ZONE OF THE GREAT LAKES,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 7C.
W83-03085

POSSIBLE INFLUENCES UPON LAKE DEVELOPMENT IN THE EAST AFRICAN RIFT VALLEYS,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
R. F. Yuretich.
Journal of Geology, Vol 90, No 3, p 329-337, 1982. 4 Fig, 2 Tab, 32 Ref.

Descriptors; *Lake morphology, *Geochemistry, *Morphology, *Africa, Lake sediments, Lake basins, Volcanoes, Rift valleys, Geohydrology, Drainage patterns, Evaporites, Chemical composition, Sediments, Geomorphology, Saline lakes.

Volcanism and climate are responsible for determining the hydrological, sedimentological, and geochemical characteristics of lakes in the East African Rift system, which consists of eastern (Ethiopia, Kenya, and Tanzania) and western (Uganda, Zaire, Zambia, Mozambique) arms. In the eastern rift extensive volcanism has disrupted drainage and increased rainfall infiltration, creating small, shallow lake basins occupying only a part of the rift width. Lake waters contain sodium, bicarbonates, and chlorides and are saline and alkaline, with total dissolved solids generally exceeding 1000 mg per liter. Eastern rift lakes often lack surface outlets and have maximum depths of 100 m. Western rift lakes are in a region of localized volcanism. They are large and deep (to 1400 m in Lake Tanganyika) with low dissolved solids, predominantly K, Mg, and sulfate. Influent and effluent rivers are common in the western rift area. Sedimentation rates are 30-50 cm per thousand years in the west and 100-300 cm per thousand years in the east. Smectite is the dominant clay mineral in the east; sediment compositions in the west are less known and more variable. Evaporites also differ in the two regions: sodium zeolites and sodium carbonate in the east and potassium zeolites, gypsum, and Mg in the west. (Cassar-FRC)
W83-03115

2I. Water In Plants

A WATER USE COMPARISON BETWEEN CORN AND SUNFLOWER,
Agricultural Research Service, Morris, MN. North Central Soil Conservation Research Center.
M. J. Lindstrom, D. D. Warnes, and S. D. Evans.
Journal of Soil and Water Conservation, Vol 37, No 6, p 362-364, November/December, 1982. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Water use, *Drought resistance, *Soil-water-plant relationships, Water consumption, *Corn, *Sunflower, Soil water, Water stress, Minnesota.

Water use of corn (Zea mays L.) and sunflower (Helianthus annus L.), reputedly drought resistant, were similar, as determined in field tests conducted in 1977-79 at Morris, Minnesota. Soil water measurements using the neutron method showed that the accumulative water use values (25-50 cm per season) did not differ by more than 5 cm between the 2 crops in any year. Less soil water was available for sunflower starting in the rapid vegetative growth period preceding the reproductive stage. Corn tended to have a higher water use than sunflower late in the season. The sunflower is susceptible to drought stress only in the 3 weeks from heading to flower completion, whereas corn is drought-susceptible over a longer period, particularly during silking through pollination and during ear filling. (Cassar-FRC)
W83-02828

MIDSEASON SOIL WATER RECHARGE FOR CORN IN THE NORTHWESTERN CORN BELT,
Michigan Agricultural Experiment Station, East Lansing.
For primary bibliographic entry see Field 2G.
W83-02890

COMBINED WATER-FERTILIZER MANAGEMENT TO MINIMIZE NON-POINT WATER POLLUTION WHILE ACHIEVING HIGH CROP PRODUCTION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
J. Letey, and W. M. Jarrell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196691, Price codes: A02 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, April 1983. 17 p, 12 Ref. OWRT B-203-CAL(1).

Descriptors: *Irrigation, *Fertilizers, *Nitrogen, Drip irrigation, Furrow irrigation, Sprinkler irrigation, Irrigation efficiency, Vegetable crops, *California, *Nonpoint pollution sources.

Greenhouse and field experiments were conducted to characterize relationships between fertilizer and water management in irrigated vegetable production in California. Greenhouse trials were conducted both in hydroponic solution culture and in soil culture, with tomatoes and lettuce, to establish functional relationships between nitrogen and water uptake by single plants, and nitrogen recovery efficiency as a function of method and rate of application and placement for simulated drip irrigation system with one fertilizer material, urea-ammonium nitrate. Over a wide range of solution culture nitrogen concentrations, the relationship between nitrogen absorbed and water absorbed by the plant was constant. Slightly more N was taken up by plants where emitters delivered it to the soil surface than where the emitter was placed 2.5 cm below the soil surface; less than 0.1% of the supplied N was recovered in acid traps as volatilized ammonia. Field trials with drip-irrigated tomatoes and celery, furrow-irrigated broccoli, celery, and corn, and sprinkler-irrigated celery and broccoli established relationships between quantity of N applied, method of N application (soil-applied soluble or slow release fertilizers, midseason sidedressing, application through irrigation water), quantity of water applied, and crop yield and nitrogen accumulation. Application of fertilizer in the irrigation was most efficient where no runoff occurred, and where plants grew rapidly. When plants grew slowly due to intermittent drought stress, nitrogen recovery efficiency was lower than where adequate but not excessive quantities of water were applied. Application of fertilizer in the irrigation water must anticipate crop nutrient demand to be effective, and must be placed in the root zone. (Snyder-California)
W83-02907

SALINITY AND BORON CONTROL UNDER HIGH-FREQUENCY LOW-VOLUME IRRIGATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 5B.
W83-02908

SOIL PORE STRUCTURAL STABILITY AND IRRIGATION WATER QUALITY: III. EVALUATION OF SOIL STABILITY AND CROP YIELD IN RELATION TO SALINITY AND SODICITY,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science and Agrometeorology.
For primary bibliographic entry see Field 2G.
W83-03025

2J. Erosion and Sedimentation

CALCIUM CARBONATE IN POSTGLACIAL LAKE ERIE SEDIMENT,
Canada Centre for Inland Waters, Burlington (Ontario).
A. Mudroch, A. J. Zeman, and L. L. Kalas.
Journal of Great Lakes Research, Vol 8, No 4, p 711-718, 1982. 7 Fig, 1 Tab, 14 Ref.

Descriptors: *Lake sediments, *Sediments, *Calcite, Bottom sediments, Geochemistry, Mineralogy, *Lake Erie, Climatology, Carbonates, Calcium carbonate.

A 16.8 m long postglacial sediment core collected from the central Lake Erie basin contained two zones of high calcium oxide and strontium concentrations at about 9-13 m and 15.5 m depths. These zones, containing up to 30% calcite, were associated with a very fine sediment, 80% of which was < 4 microns. The calcite depositions reflected two major climatic temperature increases of up to 10C, which occurred 13,000-12,000 years and 10,000-8,000 years B.P. Shear strength values of the sediments ranged from 2 kN per sq m near the lake sediment-water interface to 9 kN per sq m at the 14-16.8 m depth (the Pleistocene boundary). Concentrations of Si02, A1203, Fe203, K20, and Rb gradually decreased with depth. Illite was the most abundant crystalline phase, followed by chlorite, calcite, quartz, albite, potassium feldspar, and dolomite. Examination of mollusk shells in the sediment core showed that the sediments high in carbonate were deposited in warmer water than the sediments low in carbonate. (Cassar-FRC)
W83-02809

RUNOFF AND SOIL EROSION ON FROZEN SOILS IN NORTHEASTERN OREGON,
Agricultural Research Service, Pendleton, OR. Columbia Plateau Conservation Research Center.
J. F. Zuzel, R. R. Allmaras, and R. Greenwalt.
Journal of Soil and Water Conservation, Vol 37, No 6, p 351-354, November/December, 1982. 4 Fig, 3 Tab, 21 Ref.

Descriptors: *Soil erosion,*Frozen ground, *Snowmelt, Sediment tranpsort, Erosion, Runoff, Rainfall-runoff relationships, *Oregon, Infiltration, Soil loss.

Frozen soils, snowmelt, and rainon snow were key mechanisms in the major soil loss events recorded during the winter of 1979-80 at 4 monitoring sites in northcentral Oregon. Test sites represented conventionally tilled and planted fields in a wheat-fallow rotation. The 14 erosion-producing runoff events were associated with frozen soils, 2 with rain only and 12 with snowmelt or rain on snow. As much as 87% of precipitation ran off. Soil losses (tons per ha) were 0.5, 1.1, 29.0, and 31.0 at the 4 sites from January 12 to February 25, 1980. Precipitation intensity was not a major cause of runoff and erosion because most of the rain fell on snow. Large quantities of heat of vaporization were liberated at the snow-air interface by the high dewpoint temperature caused by warm, moist Pacific air masses. This produced a faster snowmelt than expected from sensible heat, radiation, and the heat content of rain. Condensation melt in a typical rain-on-snow event accounted for as much as 38% of total hourly melt and averaged 21% for the entire event. These results indicate that the Universal Soil Loss Equation applied to this region should be corrected for the effects of frozen soil and runoff. (Cassar-FRC)
W83-02826

HYDROLOGY, HYDRAULICS, AND SEDIMENT TRANSPORT, KANKAKEE AND IROQUOIS RIVERS,
Illinois State Water Survey Div., Champaign.
M. Demissie, N. G. Bhowmik, and J. R. Adams.
Report of Investigation 103, 1983. 66 p, 30 Fig, 11 Tab, 22 Ref.

Descriptors: *Hydrology, *Hydraulics, *Sediment transport, *River basins, *River flow, Sediment discharge, Flow discharge, Flow characteristics, Flood routing, Flood control, Storm water, Water surface profiles, Channel flow, Computer programs, *Illinois, Kankakee River, Iroquois River, Indiana.

The Kankakee is an important resource for both Illinois and Indiana and any alteration of the hydrology or hydraulics of the upstream portion of

the river will have a significant impact on the river system in either state. The sediment transport characteristics of the rivers were studied based on three years of suspended sediment data at four gaging stations. Reflecting the combined flows of the upper Kankakee and the Iroquois, the Kankakee near Wilmington is strongly influenced by the Iroquois during flood flows and the upper Kankakee during low flows. Wetlands on the Kankakee, and the differences in geology, drainage area shape, and stream slope are the main reasons for the different flow characteristics between the two rivers. Sandy soils and wetlands in the upper Kankakee Basin also provide underground and surface water storage, thereby reducing peak flows during floods and increasing low flows during dry periods. Sediment transport rating curves, relating daily sediment discharge to average daily water discharge, were developed. The impact of storm episodes was also analyzed at the four stations, and it was found that 50% of the annual sediment load in 1980 moved past three stations in only four to six days. A hydraulic analysis of the Iroquois studied the impacts of channel clearing and snagging using tow computer programs to calculate water surface profiles and to route floods. The results showed decreased water surface elevations and an increase in velocity which will increase bank erosion and, subsequently, total sediment load in the channel. The potential for more frequent flooding also increases. (Atkins-Omniplan)
W83-02921

EFFECTS OF AGGRADATION AND DEGRADATION ON RIFFLE-POOL MORPHOLOGY IN NATURAL GRAVEL CHANNELS, NORTHWESTERN CALIFORNIA,
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
T. E. Lisle.
Water Resources Research, Vol 18, No 6, p 1643-1651, December, 1982. 4 Fig, 3 Tab, 35 Ref.

Descriptors: *Channel morphology, *Sediment transport, *Aggradation, Gravel, Aquatic habitats, Habitats, Riffles, Bed load, Stream degradation, Floods, *California, Stream erosion, Stream fisheries, Stream gradient, Degradation, Erosion, Thalweg.

In December 1964 a severe flood and overwhelming sediment load in Northern California streams decreased bar roughness and diminished the contrasts in the riffle-pool sequences. Some of the 12 reaches studied widened as much as 100% and aggraded as much as 4 m, then degraded to stable levels over the next 5 or more years. The aggraded channels had finer bed material and shallower, faster, steeper flow at low to moderate flow. Bar height and pool depth decreased, and riffles eroded headward. The abundant sediment supply and the channel morphology caused increased bed load transport at relatively low discharges. As the sediment supply decreased these processes were reversed. Some channels will not recover until the sediment supply and erosion are further reduced. (Cassar-FRC)
W83-02936

SETTLING VELOCITY OF NATURAL PARTICLES,
Washington Univ., Seattle. Dept. of Geological Sciences.
W. E. Dietrich.
Water Resources Research, Vol 18, No 6, p 1615-1626, December, 1982. 10 Fig, 6 Tab, 35 Ref.

Descriptors: *Settling velocity, *Sedimentation, Particle shape, Particle size, Shape, Density.

An empirical equation was developed to describe the effects of size, density, shape, and roundness on settling velocity of natural sediments. Data from 14 previous experimental studies were used as a basis. The analysis was done in terms of 4 nondimensional parameters: dimensionless nominal diameter (D), dimensionless settling velocity, the Corey shape factor, and the Powers roundness factor. For high D (large or dense particles) changes in roundness and shape factor produced effects of similar magnitude on settling velocity. Roundness varied much less for natural grains and was less important than shape in control of settling velocity. For a typical coarse sand (Powers roundness of 3.5 and Corey shape factor of 0.7) the settling velocity was 0.68 that of a perfect sphere of the same D. Shape and roundness contributed equally to this reduction in settling velocity. At low D, the effects of roundness and shape were much less. Low roundness caused a greater decrease in settling velocity at low shape factor values than at high shape factor values. This appeared to be a result of increased surface drag on flatter grains. (Cassar-FRC)
W83-02939

EROSION OF BANKS ALONG PIEDMONT URBAN STREAMS,
North Carolina Univ. at Charlotte. Dept. of Geography and Earth Sciences.
M. P. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206292, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 189, North Carolina State Univ., Raleigh, February 1983. 38 p, 14 Fig, 1 Tab, 23 Ref. OWRT A-113-NC(1), 14-34-0001-0135.

Descriptors: *Stream erosion, *Erosion, *Bank erosion, *Stream banks, Banks, Urban drainage, Slope degradation, Urban areas, North Carolina, Piedmont streams.

Urbanized and non-urbanized tributary streams of the Piedmont are usually cut into post-European reddish sands and pre-European-settlement gray cohesive soils. These streams are eroding by scour and bank failure. Currently, berms (or inner-channel terraces) are a common product of bank failure; otherwise inner-channel deposition is rare and consists of point bars formed as meanders begin to develop. The cohesive sediments are more scour resistant than the sandy sediments. Bank failure is of the slab type, and is a normal part of the erosion process. Traditional design approaches have failed to create stable channels, primarily because (1) we do not understand erosive processes in cohesive sediment, and (2) urban environments require abnormally narrow channels. Erosion in channels less than about twelve feet deep can be reduced significantly by consideration of natural fluvial processes, artificial berm development, and judicious use of rip-rap. Torvane strength, color, composition and particle size distribution readily characterize bank materials and their erodibility.
W83-02945

DAM AND RIVER SAND-DRIFTING INSPECTION (LA BATHYMETRIE--TECHNIQUE DE SURVEILLANCE DE L'ENSABLEMENT DES FLEUVES ET DES RETENUES),
Travaux Sous-Marins, Peney (Switzerland).
P. Martin.
Wasser, Energie, Luft, Vol 73, No 10, p 218-220, October, 1981. 7 Fig. English summary.

Descriptors: *Bathymetry, *Sand, *Bottomm sediments, Hydroelectric plants, Sounding, Water depth, Siltation, Sedimentation, Power plants, Dams, Lessoc, *Switzerland, Reservoir silting.

Precision bathymetric techniques permit the observation of the evolution of sand drifts in a relieving tackle. Comparisons of echo-sounding recordings show, season after season and year after year, all the variations in bottom depths and contours. This allows identification of the location of accumulation zones and calculation of the volume of the sediments deposited around the water gates of dams. Inspection of these mechanisms enables draining off and cleansing of the relieving tackle. Both the equipment and the technique used to draw a sea-chart are described, and the application of this technique to hydroelectric power plants is discussed. The inspection of sand drifts at the Lessoc water power plant of the 'Enterprises Electriques Fribourgeoises' is used to demonstrate the usefulness of this procedure. (Author's abstract)
W83-02961

EFFECTS OF A FLOODWATER-RETARDING STRUCTURE ON THE HYDROLOGY AND ECOLOGY OF TROUT CREEK IN SOUTHWESTERN WISCONSIN.
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 6G.
W83-02985

A NUMERICAL STUDY OF RAINDROP IMPACT PHENOMENA: THE RIGID CASE,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
C. Huang, J. M. Bradford, and J. H. Cushman.
Soil Science Society of America Journal, Vol 46, No 1, p 14-19, January/February, 1982. 11 Fig, 16 Ref.

Descriptors: *Erosion, *Rainfall impact, *Soil erosion, Marker-Cell method, Soil Strength.

The impact of spherical raindrops on a rigid surface was studied using the Marker and Cell numerical technique. Results showed that impact pressures were very high (1050-1200 kPa) at the instant of impact and diminished to 200 kPa, about 5 times the steady-state stagnation pressure, after 5 microseconds. Maximum pressure was at the circumference of the water drop contact surface. The pressure gradient within the drop decreased very quickly. The lateral jetting velocity was twice the impact velocity. This high velocity lateral jet stream is probably the crucial mechanism in detachment of soil by raindrops. Three critical factors are important in defining resistance against raindrop impact: soil deformation characteristics, soil shearing strength, and surface microrelief. (Cassar-FRC)
W83-03029

SEDIMENT TRANSPORT IN ALLUVIAL CHANNELS: RATES FOR EROSION AND DEPOSITION OF COHESIVE SEDIMENTS LITERATURE REVIEW AND EXPERIMENTAL DESIGN,
Oklahoma State Univ., Stillwater. Dept. of Chemical Engineering.
J. Wagner, and S. -P. Kuan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206797. Oklahoma Water Resources Research Institute Completion Report, Oklahoma State Univ., Stillwater, March 1983. 65 p, 6 Fig, 1 Tab, 144 Ref. 1 Append. OWRT A-094-OKLA(2), 14-34-0001-1138.

Descriptors: *Erosion rates, *Experimental design, *Open channels, *Sedimentation rates, *Test facilities, Alluvial channels, Channel erosion, Deposition, Fabrication, Flumes, Hydraulic transportation, Open-channel flow, Pumps, Sediment erosion, *Sediment transport, Sediments, Silting, Soil erosion, Soil properties, Suspended sediments, Tractive forces.

Nationally sediment pollution exceeds all other types including those from municipalities and industries. Sediment is recognized as a dangerous multiple pollutant since it may carry other contaminants such as herbicides, pesticides, tosic metals, and plant nutrients adsorbed on particles surfaces. Evaluation of water quality improvements which might be derived from alternative control techniques will require methodologies for predicting the transport and distribution of sediments and associated contaminants in alluvial channels on agricultural and silvicultural watersheds. The mechanisms of hydraulic erosion and deposition of cohesive sediments are extremely complex and depend not only upon the hydraulic regime, but also upon the physicochemical forces between sediment particles. The strength and number of bonds between particles of cohesive sediment are influenced by the sediment mineralogy, mode of deposition, and the chemical quality of the pore and eroding fluids. A review of the literature has been conducted to describe the progress toward understanding the mechanisms of hydraulic erosion and deposition of cohesive sediments. At the present time there are not methods for predicting rates of erosion or deposition which do not require field or laboratory erosion or deposition studies.

An experimental tilting recirculating flume has been designed to aquire data which can be used in empirical models for rates of erosion and deposition of cohesive sediments. It can be used to develop more detailed mechanistic models. Factors which must be considered in the design of a flume which will handle sediment suspensions are discussed, and guidelines for experimental procedures for erosion and deposition studies are outlined. W83-03032

EFFECTS OF FARMING PRACTICES ON SEDIMENT IN IRRIGATION RETURN FLOW,
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4D. W83-03039

A STUDY OF THE BED-LOAD YIELD FROM A WATERSHED,
Clemson Univ., SC. Dept. of Civil Engineering.
H. S. Woo, J. S. Fisher, B. L. Sill, and S. Nnaji.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208561, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Institute Publication No 100, Clemson Univ., S. C., March 1983. 97 p, 28 Fig, 17 Tab, 27 Ref, 6 Append. OWRT A-050-SC(1), 14-34-0001-1143 and 0143.

Descriptors: *Sediment yield, *Watersheds, *Bed load yield, *Hydrographs, Sedimentation basins, Sediments, Water, Settling basins, Runoff, Mountains, Rainfall, Storm runoff, North Carolina.

It has been shown that small experimental watersheds are indicative of their respective physiographic regions. It is in this context that Watershed 22 of the Coweeta Hydrologic Laboratory, North Carolina encompassing an area of 356,000 m super 2, was chosen for studies pertaining to bed-load yields. Sediment samples were taken by diverting stream flow around the gaged stilling basin at the base of the watershed draining the basin, and physically removing the sediment. The sample was transported to the Clemson Hydraulics Laboratory for analysis. Sediment yields for seven collection periods varied from 3.8 kg to 78.2 kg. Elapsed time between samples varied from 5 days to 34 days. A satisfactory predictive bed-load equation was obtained by dividing the hydrograph into base flow and run-off volumes. The run-off volume was normalized by the number of days elapsed. The resulting run-off sediment yield equation is K(kg) = 6.65 x 10 super -3 (V sub R)1.19 with V sub R the normalized runoff volume in m super 3/day. This is a useful result in that it enables the prediction of sediment yields from any area with similar forest cover conditions no matter what the stage of a stream at the time of study. To test the efficiency of the sediment collecting methods described in this report, the sediment data were compared with the results of a study conducted at another watershed within the same locality. The results were shown to be quite accurate. W83-03096

MOBILIZATION, MOVEMENT AND DEPOSITION OF ACTIVE SUBAERIAL SEDIMENT FLOWS, MATANUSKA GLACIER, ALASKA,
Cold Regions Research and Engineering Lab., Hanover, NH.
D. E. Lawson.
Journal of Geology, Vol 90, No 3, p 279-300, 1982. 13 Fig, 1 Tab, 49 Ref.

Descriptors: *Glacial sediments, *Sediment transport, *Ice, Matanuska Glacier, *Alaska, Till, Diamicton, Deposition, Melting, Fluid flow, Shear, Sediment-Carrying capacity.

Subaerial sediment flows, which deposit diamictons at the terminus of Matanuska Glacier, Alaska, were investigated during 1974-79. The flows originate where sediments overlie glacier ice. Ablation of ice on slopes releases the sediment and mixes it with melt water and debris. Sediment begins to flow as a result of excess pore pressures and seepage pressures produced by melt water. Sediment flows vary widely in dimensions, texture, flow rates, density, erosional action, grain support, and transport mechanisms which depend on changes in water content of the material. At low water contents, flows support grains by their strength and move through shear in a thin zone at their base. Increased water content increases the thickness of the shear zone and produces deformations such as grain interference and collisions, localized liquefaction and fluidization, transient turbulence, and bedload traction. Flows with maximum water content are fully liquified and well-mixed. Mobilization of a sediment flow changes the glacial sedimentary properties of its source. Therefore, the diamicton deposited by sediment flow should not be called till. (Cassar-FRC) W83-03116

SOURCES, SINKS, AND STORAGE OF RIVER SEDIMENT IN THE ATLANTIC DRAINAGE OF THE UNITED STATES,
Geological Survey, Denver, CO.
R. H. Meade.
Journal of Geology, Vol 90, No 3, p 235-252, 1982. 12 Fig, 3 Tab, 72 Ref.

Descriptors: *Sediment transport, *River basins, *Erosion rates, Fate of pollutants, *Atlantic coast, Sediment discharge, Sediment erosion, Sediment load, Sediment yield, Reviews, Streamflow, Storage, Soil erosion, Reservoir silting, Silting, Flood plains, Marshes, Estuaries, Agriculture, Coastal marshes, Coastal plains, *Coastal streams, Suspended sediment.

Difficulties in modeling sediment on a river basin scale are shown in a review of sediment and its movement in Atlantic drainage rivers. Sediment-streamflow relationships vary widely during seasons and among rivers. Highest sediment concentrations and yields are in southern Piedmont rivers; lowest concentrations and yields are in southern Coastal Plain rivers. In many rivers half the sediment is discharged in 1% of the time and 85-95% of the sediment in 10% of the time. This shows that a given sediment particle spends much time in storage and very little time in transport. On a millennial scale soil erosion is the original source of river sediments. The erosion rate increased dramatically in the 17th century as European settlers cleared forests and started farming. Erosion has been most severe in the lower Piedmont of South Carolina and Georgia. Improved soil conservation practices and a decrease in cropland area have decreased erosion rates. However, so much sediment is in storage in rivers, reservoirs, flood plains, and hillslopes that river sediment loads have not decreased. It is estimated that a century or more will be required to clear valley bottoms of excess sediment. Sediments stored further from the river may take much longer to move through the system. For example, most of the hydraulic mining debris on the Sacramento River flood plain remains where it was deposited 100 years ago. Reservoirs that hold a tenth of the annual water flow can trap 80-90% of inflowing sediment. Severe floods can release large amounts of sediment. Channels below reservoir experience accelerated erosion. The ultimate sinks for river sediments and associated contaminants in the Atlantic drainage are the estuaries and marshlands. Only 5% of the sediment load reaches the continental shelf or deep sea. (Cassar-FRC) W83-03117

TURBIDITY IN THE WESTERN BASIN OF LAKE ERIE,
Environmental Protection Agency, Narragansett, RI.
J. F. Paul, R. Kasprzyk, and W. Lick.
Journal of Geophysical Research, Vol 87, No C8, p 5779-5784, July 20, 1982. 9 Fig, 1 Tab, 15 Ref.

Descriptors: *Turbidity, *Lake sediments, *Sediment transport, Fate of pollutants, Intakes, *Lake Erie, Maumee River, *Ohio, Water supply, Suspended sediment, Suspended solids, Wave action, Shear stress, Bottom sediments.

A formula for describing turbidity as a function of bottom shear stress due to wave action and sediment loading from a river was developed using data from the Oregon, Ohio, municipal water intake, located near the Maumee River outlet in Lake Erie's western basin. Excellent agreement was obtained between observed and calculated turbidities for 1977 (the year used to determine the coefficients) and 1976, 1978, and 1979. Results show that turbidity is directly related to wave action and the resulting bottom stress. Turbidity is not closely related to wind magnitude or wind direction. Sediments from the Maumee River significantly contribute to the amount of entrainable sediment near the intake. Sediment loadings, highest in spring, show a highly seasonal variation. High turbidity is produced by the transport of suspended solids from the Maumee River to the intake. There is a reasonable equality between turbidity in NTU units and suspended sediment concentrations in units of mg per liter. (Cassar-FRC) W83-03118

SEDIMENTATION AND ITS CONTROL IN NADIS IN THE INDIAN ARID ZONE - A CASE STUDY,
Central Arid Zone Research Inst., Jodhpur (India).
K. D. Sharma, and D. C. Joshi.
Journal of Arid Environments, Vol 5, No 3, p 269-276, 1982. 5 Tab, 5 Ref.

Descriptors: *Sedimentation, *Arid zones, *Vegetation, Sediment transport, Rainfall, Erosion control, Sand, Alluvial deposits, Nadis, *India, Storage capacity, Storage reservoirs, Water storage.

Sandy and eroded rocky catchments in association with torrential rainfall are the main causes of heavy sediment deposition in nadis (small water storage structures) and markedly reduce their capacity. A study was made of 117 nadi samples, selected by a stratified random sampling technique. Sediments in nadis occurring in the sandy plain environment were mainly composed of 49.2-81.3% fine to very fine sand, 4.4-19.7% silt and 9.5-23.5% clay. In nadis non-vegetated catchments, the sediment yield and sediment production rate increases sharply with the rainfall and slope groups. Dunes in the region are stabilized with intermittently exposed older alluvium. Therefore the sand fraction is prevented from being carried away with the runoff, and thus the sediments contain a higher proportion of silt and clay and less sand than the sandy plain catchments under the same rainfall zone. Younger alluvial deposits in this area are assemblages of a variety of coarse to fine textured soils and occur along the banks of ephemeral channels and in depressions. The sediment deposited in the nadis in this setting consists of 52.9-77.8% coarse to fine sand, 4.8-11.9% silt and 7.0-26.7% clay and a slightly higher proportion of gravels than in the sandy plain catchments. The older alluvial formations in this region are composed of coarse to medium sand, gravels and grit cemented with secondary calcium carbonate. It was evident from the study that sediment in the sandy plain, dune complex, younger and older alluvial settings can be reduced significantly by introducing vegetation in the catchments. (Baker-FRC) W83-03133

RUNOFF AND WATER QUALITY FROM THREE SOIL LANDFORM UNITS ON MANCOS SHALE,
Bureau of Land Management, Denver, CO. Div. of Special Studies.
W. L. Jackson, and R. P. Julander.
Water Resources Bulletin, Vol 18, No 6, p 995-1001, December, 1982. 7 Fig, 4 Tab, 10 Ref.

Descriptors: *Sediment transport, *Erosion, *Saline water, Sediment concentration, Sediment control, Sediment load, Sedimentary rocks, Mancos shale, Shales, Runoff, Price River, *Utah, Rainfall-runoff relationships, Suspended sediment, Infiltration, Channel scour, Soil creep, Rill erosion, Water pollution sources, Water quality control.

Simulated rainfall was applied to three landforms underlain by Mancos shale in the Price River Basin, Utah, to determine the relative yields of water, sediment, and salt from this saline sedimentary formation. The three types of soil were: (1) soil A-shale pediment/recent alluvium, (2) soil D-

shale pediment/recent alluvium, and (3) soil A and weathered shale dissected Mancos shale uplands. Final infiltration rates on residual shale derived soils were 0.13-0.50 cm per hour. No runoff was generated on cracked soils derived from aeolian deposits. A steep dissected Mancos shale upland produced 180 times the suspended sediment concentrations and 68 times the EC (indicating salinity) compared to a low relief shale pediment and recent alluvial surface. Rilling was responsible for 80% of the sediment produced on the steep dissected shales. Channel scour and soil creep were also significant contributors to sediment. An estimated 1.35 million g per ha per year of sediment is produced by the steep dissected shale uplands. Sediment plugs were effective in trapping sediments on a local basis to improve quality of water for stock ponds and irrigation canals. (Cassar-FRC)
W83-03150

2K. Chemical Processes

CALCIUM CARBONATE IN POSTGLACIAL LAKE ERIE SEDIMENT,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 2J.
W83-02809

RADIUM, THORIUM AND RADIOACTIVE LEAD ISOTOPES IN GROUNDWATERS: APPLICATION TO THE IN SITU DETERMINATION OF ADSORPTION-DESORPTION RATE CONSTANTS AND RETARDATION FACTORS,
Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.
S. Krishnaswami, W. C. Graustein, K. K. Turekian, and J. F. Dowd.
Water Resources Research, Vol 18, No 6, p 1633-1675, December, 1982. 7 Fig, 8 Tab, 34 Ref.

Descriptors: *Radioisotopes, *Solute transport, *Adsorption, Fate of pollutants, Aquifers, Isotopes studies, Radium, Thorium, Lead, *Connecticut, Uranium, Radon, Polonium, Sorption, Groundwater, Radioactive wastes, Geochemistry, Chemistry, Chemical properties.

Five groundwater samples collected in different hydrogeologic settings (glacial drift acquifer, crystalline bedrock arkosic rocks of the Triassic-Jurassic age, and a deep unpumped well) in Connecticut were analyzed for the concentrations of major cations and the U and Th decay series, U238, Th234, Ra226, Rn222, Pb210, Po210, Th232, Ra228, Th228, and Ra224. Waters were all toxic and slightly alkaline, with < 2500 ppm total dissolved solids. The concentrations of Rn222 ranged from 845 to 11,900 decays per min per liter, which were 3-4 orders of magnitude greater than that of the short-lived Ra224, Ra228, and Th234, even though the supply of the four isotopes is similar. It was inferred that sorption removes Ra and Th from groundwater in about 3 min or less. The activity ratios of Ra224/Ra228 and Th234/Th228 show that desorption occurs in about 1 week or less and that equilibrium between solution and surface phases is established. Therefore, in situ retardation factors can be calculated directly from the isotopic data. These are 4500 to 200,000 for various nuclides in different aquifers. Since sorption time scales and retardation factors are not dependent on the specific nuclide or the hydrogeology of the aquifer, it is likely that other uncomplexed heavy metals and transuranic elements will behave similarly. These relationships may be applied to studies of transport of radioactive waste through saturated media. (Cassar-FRC)
W83-02937

NATURE AND EXTENT OF ACID SNOWPACKS IN PENNSYLVANIA,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 2C.
W83-02943

CHEMICAL COMPOSITION OF BULK PRECIPITATION IN THE NORTH-CENTRAL AND NORTHEASTERN UNITED STATES, DECEMBER 1980 THROUGH FEBRUARY 1981,
Geological Survey, Albany, NY. Water Resources Div.
N. E. Peters, and J. E. Bonelli.
Available from the Br. of Dist. USGS, 604 S. Pickett St. Alexandria, VA 22304. Geological Survey Circular 874, 1982. 63 p, 20 Fig, 5 Tab, 28 Ref.

Descriptors: *Chemistry of precipitation, *Snow, *Deposition, *Chemical analysis, Trace metals, Snow samplers, Sampling, Sites, *Bulk precipitation, North-central United States, Northeastern United States.

Bulk precipitation samples were collected at 180 sites in the north-central and north-eastern States for 3 months during winter 1980-81 to provide data on the distribution of chemical constituents. Concentrations and average daily loads of 28 dissolved constituents were determined. Sodium and chloride deposition was relatively high in coastal areas and near someurban centers. Regional patterns of hydrogen ion, nitrate, lead, and iron loading correlate well with each other and form a concentric pattern around the center of high deposition in eastern Ohio and western Pennsylvania, suggesting an urban-industrial source. Samples from this area had low pH (<4.2), whereas samples from southern Minnesota and Illinois had circumneutral pH (<5.7). The latter samples had high concentrations of calcium and total inorganic carbon, suggesting pH control by soil-derived carbonate minerals. Deposition patterns of ammonium, nitrate, and sulfate display regional highs in Illinois, Indiana, and southwestern Michigan, suggesting agricultural sources such as fertilizer. Median loads of zinc, iron, and lead were lower than reported in previous studies for North America. The apparent decrease in lead since 1950 throughout the area is attributed to reduced consumption of leaded fuels and lower deposition in winter. (USGS)
W83-02968

SALT GENERATION IN PYRITIC COAL SPOILS AND ITS EFFECT ON SATURATED HYDRAULIC CONDUCTIVITY,
Kentucky Agricultural Experiment Station, Lexington.
For primary bibliographic entry see Field 5B.
W83-03024

NUTRIENTS AND ACID IN RAIN AND DRY FALLOUT AT FAYETTEVILLE, ARKANSAS (1980-1982),
Arkansas Univ., Fayetteville. Dept. of Geology.
G. H. Wagner, and K. F. Steele.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208264, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 90, Univ. of Arkansas, Fayetteville, April 1983. 92 p, 24 Fig, 8 Tab, 14 Ref. OWWR A-051-ARK(1), 14-34-0001-0104.

Descriptors: *Acid rain, Metals, *Nutrients, *Rain, Fayetteville, *Arkansas, *Ion flux, Wind direction, *Atmospheric deposition, *Hydrogen ion concentration, Heavy metals, Iron, Zinc, *Chemistry of precipitation.

Wet and dry fallout at Fayetteville, Arkansas have been collected separately and analyzed since April, 1980. The precipitation-weighted-average pH for two yearly periods of rainfall were 4.72(6/80-5/81) and 4.75(6/81-5/82). This corresponds to a concentration of the acid ion, H super +, of about 18 parts per billon (ppb). Pure water in equilibrium with the CO sub f the air would have a pH of 5.65(2.2 ppb of H super +). The range of pH during this two year period was 3.86-4(140-0 ppb H super +) for the rainfall. Aqueous extracts of the dry fallout were always in the 6.75-7.87 pH range, i.e. ne utral to slightly alkaline. The slight amount of acidity in the Fayetteville rainfall should be easily neutralized by dry fallout and soil. Amonium bisulfate, NH sub 4 HSO sub 4; is the major acidic chemical in the rains. Sulfur tends to increase in winter months presumably due to the greater use of fossil fuels. Northern rains have the most acidity. Wet and dry fallout add significant amounts of nutrients to the local soils with 25-87% of the total flux being dry fallout. A major contributor are dust storms which bring in soil from adjacent states. Iron and zinc were the most prevalent heavy metals in the wet fallout. Their concentrations were very low averaging less than 10 ppb for Fe and 15 ppb for Zn. Northernly and southernly rains had the most Fe and Zn and correspond to directions in which there are smelters.
W83-03041

VARIATIONS IN GROUNDWATER QUALITY WITH DROUGHT,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 5B.
W83-03044

METABOLIC PROPERTIES OF THIOBACILLUS FERROOXIDANS ISOLATED FROM NEUTRAL PH MINE DRAINAGE,
Alaska Univ., Fairbanks. Inst. of Water Resources.
For primary bibliographic entry see Field 5B.
W83-03045

POSSIBLE INFLUENCES UPON LAKE DEVELOPMENT IN THE EAST AFRICAN RIFT VALLEYS,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
For primary bibliographic entry see Field 2H.
W83-03115

CHEMISTRY OF SOUTH POLAR SNOW,
Laboratoire de Glaciologie et Geophysique de l'Environnement, Grenoble (France).
R. Delmas, M. Briat, and M. Legrand.
Journal of Geophysical Research Vol 87, No C6, p 4314-4318, May 20, 1982. 4 Fig, 2 Tab, 30 Ref.

Descriptors: *Snow, *Acidity, *Chemical composition, *Salts, *Antarctic, Precipitation, Trace elements, Aerosols, Deposition, Air entrainment, South Pole, Sulfates, Nitrates, Chlorides, Ammonium.

Data on the chemical composition of trace impurities in recent Antarctic snow is reviewed and analyzed. Sea salt is an important source of trace impurities in the coastal areas but not at the interior South Pole region (10-15% of total trace element deposition). Sodium concentrations in snow (times 10 to the minus 9th power g per g) were > 400 at the coast and as low as 4 at a distance 500-600 km from the sea. Impurities are essentially soluble (about 96%). The gas-derived ions (sulfates, nitrates, ammonium, and chlorides) are the major components in central Antarctic snow. Electro-conductivity measurements indicate a large proportion of hydrogen ions (38%) among the cations, which also include ammonium (10%) and sodium (6%). Antarctic snow melt water can be described as a very dilute mixture of natural acids, such as sulfuric and nitric, of pH 5 to 7, containing about 25% neutral salts. Possible origins of the chemical impurities are: sulfate--oxidation of marine gaseous compounds and deposition of volcanic sulfate; nitrate and ammonium--solar activity; and chloride--sea salt plus gaseous hydrogen chloride formed by reaction of sea salt and sulfuric acid in the atmosphere. (Cassar-FRC)
W83-03119

2L. Estuaries

MATHEMATICAL MODELLING OF ESTUARIES AND COASTAL WATERS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James.
Water Science and Technology, Vol 14, No 9-11, p 1109-1123, 1982. 2 Tab, 125 Ref.

Descriptors: *Estuaries, *Model studies, *Planning, Coastal waters, Bacteria, Decision making, Water management, Water quality control, Mathematical studies, Water pollution control.

Modeling of estuaries and coastal waters has proceeded on divergent lines, since the common pollution problems in the two situations are different and the mechanisms responsible for dilution in the two waters are somewhat different. In estuaries the water quality if closely linked with the level of dissolved oxygen, with acute toxins as a secondary parameter. The greater dilution in coastal waters usually obviates any problems of deoxygenation or acute toxicity, so visual amenity and microbiological quality are the primary concerns. In coastal waters the initial mixing of the waste is due to entrainment of seawater in the buoyant jet and subsequently to advection and turbulent diffusion at the surface in a relatively unconfined area. Discharges to estuaries usually occur at or near the surface, so dispersion by advection and turbulent diffusion takes place in a confined area, where differences vertically and laterally may often be neglected. Various modeling factors used in these situations include hydraulic classification, validation and sensitivity analysis, economic models, modeling of initial dilution, modeling of surface spreading, and modeling of bacterial die-off. (Baker-FRC)
W83-02867

NUTRIENT-SALINITY RELATIONSHIPS IN FOUR ESTUARIES OF THE CAPE PROVINCE, SOUTH AFRICA,
National Research Inst. for Oceanology, Stellenbosch (South Africa).
For primary bibliographic entry see Field 5B.
W83-02889

ON LAGRANGIAN RESIDUAL CURRENTS WITH APPLICATIONS IN SOUTH SAN FRANCISCO BAY, CALIFORNIA,
Geological Survey, Menlo Park, CA.
R. T. Cheng, and V. Casulli.
Water Resources Research, Vol 18, No 6, p 1652-1662, December, 1982. 10 Fig, 26 Ref.

Descriptors: *Water circulation, *Water currents, *Lagrangian circulation, Bays, Estuaries, *San Francisco Bay, *California, Eulerian ciculation, Tidal effects, Tidal currents, Stokes' drift, Residual circulation, Wind-driven currents.

Following a classification and definition of residual variables in tidal estuarine flow, a method is outlined in which the Lagrangian residual circulation is computed directly using a two-stage formulation. First the tidal circulation in a basin is computed from the shallow water equations in a conventional Eulerian manner. Then tracer particles are released and followed by a numerical scheme patterned after the method of markers and cells. This approach was applied to South San Francisco Bay, California, which has a deep relict channel connected to a broad shallow shoal east of the channel. No major river flows into South Bay, and the tides here have properties similar to standing waves. It is concluded that estimating Lagrangian residual circulation from Eulerian data may be unacceptable because they are conceptually different and will never be the same. There is a small difference between the variables in the south end of the bay, but large differences near the center of the basin, where a sharp gradient exists between the channel and shoals. The two variables show a relationship only when tidal excursion is small compared to the topographic features of the basin (length scale of the basin). Wind forcing was found to play an important role in long-term circulation. (Cassar-FRC)
W83-02928

FLOW MODEL OF THE HUDSON RIVER ESTUARY FROM ALBANY TO NEW HAMBURG, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
D. A. Stedfast.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-110007, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-55, 1982. 69 p, 9 Fig, 3 Tab, 20 Ref.

Descriptors: *Computer models, *Estuaries, *Streamflow, *Unsteady flow, Surface water, Tidewater, Mathematical models, Discharge measurement, Data collections, Hydrographs, *New York, Hudson River estuary.

A one-dimensional transient-flow-simulation model was developed to represent a 76-mile reach of the tidal Hudson River between Albany and New Hamburg, N.Y. The river's direction of flow reverses four times daily as a result of tidal influence, and this process produces complex current patterns and retards the rate at which the river can flush out pollutants. In the model, the reach studied is treated as two subreaches to incorporate differences in channel conditions and to simplify model calibration. This report provides all stage (water-level) and discharge data that were used to calibrate and verify the model and compares the model results with measured data. The model accurately simulated observed flows, but further calibration based upon additional prototype flow measurements would improve simulation of the flow magnitude and phasing of the tide reversal under low-flow conditions. The model can be used to calculate instantaneous stage, velocity, and discharge for any location in the reach and can also be used to calculate net volume flux between tide reversals. (USGS)
W83-02986

COUPLING OF ONE- AND TWO-DIMENSIONAL FINITE ELEMENTS FOR THE COMPUTATION OF TIDAL FLOW IN ESTUARIES,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
B. Herrling.
Advances in Water Resources, Vol 5, No 4, p 227-232, December, 1982. 14 Fig, 11 Ref.

Descriptors: *Estuaries, *Tidal flows, *Model studies, Mathematical equations, Fluid mechanics, Hydraulics, *Finite element method, Mathematical studies, Elbe River estuary, *Federal Republic of Germany.

A new method for the numerical computation of tidal flow in estuaries is demonstrated. One- and two-dimensional finite elements are directly coupled in a single model requiring the solution of only one common set of equations for all unknown parameters in each time step. The inland region of the Elbe River and the channel system on the intertidal flats are modeled by applying a one-dimensional analysis, while the south-eastern part of emonstrated that water levels and discharges can be correctly computed by the model for the whole estuary region. The computed water levels are compared with measured hydrographs at different gauges on the Elbe River. It is emphasized that by using a one-dimensional analysis in parts of the model much computer time can be saved. Moreover it is possible, applying the new coupling mechanism, to reproduce special parts of a model by a two-dimensional discretization, for example, the area of construction in a river. (Baker-FRC)
W83-03051

COLLOCATION FORMULATIONS FOR THE FINITE ELEMENT ANALYSIS OF TIDAL AND TRANSPORT PROCESSES IN ESTUARIES,
Hanover Univ. (Germany, F.R.).
U. Meissner, and R. Ratke.
Advances in Water Resources, Vol 5, No 4, p 217-220, December, 1982. 2 Fig, 7 Ref.

Descriptors: *Estuaries, *Transport, *Tidal effects, Sediment transport, Estuarine environments, Tidal basins, Tidal currents, Waves, Heat transport, Thermal pollution, Thermal water, Heated water. *Finite element analysis.

The finite element method supplies a high flexibility for the modeling of complicated systems via its features of irregular mesh refinements and its ability of coupling different elements. Although the method is theoretically well analyzed and proves reliable, numerical problems remain which must be weighed with regard to accuracy and computer costs. The theoretical background of this approach is outlined. For the analysis of long-period tidal waves and the heat transport within the far-field of coastal waters, the governing equations are derived by vertical integrations over the water depth under the following assumptions: density gradients and velocity components in the vertical direction are negligible, the water is well mixed over the depth, and the influence of the temperature distribution on the tidal motion is negligible. For clearness of the derivation, only a formulation for one-dimensional models with rectangular width cross-sections is presented. A simulation of the thermal transport in a river under natural conditions has shown that the explicit model as described meets the requirement of being able to keep sharp fronts between cold and hot water as they may occur in a tidal river. (Baker-FRC)
W83-03055

STREAM FUNCTION FINITE ELEMENTS FOR NEARSHORE CURRENT,
Chuo Univ., Tokyo (Japan). Dept. of Civil Engineering.
M. Kawahara, and T. Takagi.
Advances in Water Resources, Vol 5, No 4, p 195-207, December, 1982. 27 Fig, 22 Ref.

Descriptors: *Coastal waters, *Mathematical equations, *Nearshore processes, *Water currents, Waves, Flow, Surface water, *Japan, Twan Bay, Streamflow, Streams, *Finite element analysis.

The finite element method is presented for the determination of surface wave and nearshore current. For the surface wave, the analysis of wave angle and wave height was carried out. The basic equations of wave angle and height variations are expressed by the conservation of wave number and wave energy respectively. The wave angle is determined from the conservation law of wave number. Radiation stress is derived from the wave angle and height. The nearshore current flow is obtained from the conservations of momentum and continuity, including the radiation stress. All the numerical procedures are based on the finite element method. For the analysis of the wave angle and wave height, the incremental iteration method and logarithmic function formulation are employed. For the analysis of the current flow, the stream function formulation is used. From the numerical computations, it is seen that the finite element method presented is valuable in practical applications. The method is applied to the analysis of the nearshore current flow of Twan Bay in Japan. (Baker-FRC)
W83-03064

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SANITARY MICROBIOLOGIC ASSESSMENT OF WATER DESALINATION BY DISTILLATION (SANITARNO-MIKROBIOLOGICHESKAYA OTSENKA DISTILLYATSIONNOGO METODA OPRESNENIYA VODY),
Institute of General and Municipal Hygiene, Moscow (USSR).
Yu. A. Rakhmanin, A. I. Melnikova, and D. A. Selidovkin.
Gigiena i Sanitariia, No 1, p 12-15, 1980. 4 Ref. English summary.

Descriptors: *Desalination, *Evaporators, *Microorganisms, Water quality, *Distillation, Water pollution, Water pollution sources, Bacteria, Water vapor, Seawater, Drinking water, *Water treatment, *Microbiology, *USSR.

The desalination of highly mineralized waters on industrial evaporators may lead to a greatly reduced level of microbial contamination of the distillate, but this decontamination is not reliable. Microorganisms can be introduced from water vapor to the distillate due to the high vacuum within the inner circuit of the evaporator. Thus, the desalinated water must be purified by one of

the techniques commonly used for drinking water. (Author's abstract)
W83-03010

DESIGN AND EVALUATION OF AN AFVC WASH COLUMN WITH DIRECT MELTING ON THE ICE PLUG,
Heist Engineering Corp., Walnut Creek, CA.
J. A. Heist, and T. S. Barron.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206870, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, April 1983. 54 p, 6 Fig, 4 Tab, 33 Ref, 3 Append. OWRT(No 2416)(1), 14-34-0001-2416.

Descriptors: *Desalination plants, *Crystallization, *Distillation, Sea water, Water treatment, Industrial plants, Pilot plant, Mathematical studies, Finite crystallization, AFVC pilot plant, *Direct melt wash column.

Heist Engineering and the Office of Water Research jointly developed and satisfactorily tested a small-scale side stream direct melt wash column for the AFVC desalination pilot plant at the Wrightville Beach Test Facility. This evaluation of the direct melt approach was motivated by problems experienced with the existing AFVC wash column, particularly the air leaks that have been observed through the scraper shaft seal. The program also included a review of wash column design practice, and the identification of methods appropriate for design of commercial-scale direct melt units. Results at the small scale suggest that continued research, including both the conversion of the existing AFVC wash column to direct melt operation, and further development of design methods, should be pursued.
W83-03040

ENERGY RECOVERY FROM THE REJECT BRINE OF REVERSE OSMOSIS SYSTEMS,
Bechtel National, Inc., San Francisco, CA.
S. C. May, R. Soo-Hoo, D. J. Prend, and A. N. Rogers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-209031, Price codes: A04 in paper copy, A01 in microfiche. Final Report, March 1981. 57 p, 19 Fig, 9 Tab, 9 Ref. OWRT C-90302-D(9528)(1), 14-34-0001-9528.

Descriptors: *Energy recovery, Flow work exchanger, Immiscible fluid energy recovery device, *Reverse osmosis, *Cost-energy recovery, *Desalination, Desalination plants, Brine, Seawater, Design, Performance.

A novel power recovery system, immiscible fluid energy recovery device (IFERD), for reverse osmosis desalting plants was investigated. Conceptual designs and cost estimates were developed for two commercial-sized seawater reverse osmosis desalting plant applications. An economic evaluation of the IFERD system when compared to conventional power recovery devices shows the IFERD system to be more economically attractive in most cases, except when power costs are extremely low. This is mainly due to its superior efficiency in both the recovery of energy and the application of the recovered energy. In addition, the IFERD system offers potentially increased reliability and reduced maintenance. Recommendations are made for pilot testing to demostrate the performance and reliability of the IFERD system and to obtain other data necessary to develop the IFERD system to the point of commercial use.
W83-03113

3B. Water Yield Improvement

OPTIMAL DESIGN OF SMALL RESERVOIR SYSTEMS,
P. N. Sharma, and O. J. Helweg.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No 4, p 250-264, December, 1982. 6 Fig, 4 Tab, 9 Ref.

Descriptors: *Reservoir design, *Irrigation water, *Water harvesting, Optimization, Water supply, Semiarid lands, Hyderabad, *India, Ponds, Tropical regions, Water storage, Storage tanks, Design criteria, Systems analysis.

Systems analysis was applied to the design of tank systems suitable for water harvesting in the semiarid tropics. The tanks are actually small reservoirs formed by earth dams or small excavated ponds to catch precipitation during the monsoon and hold it for use during the dry season. Tank volume, location, and dimensions are the components considered in the optimization problem. Some cases are constrained by catchment size, others are unconstrained. A sample problem for a catchment in Hyderabad, India, is given for both constrained and unconstrained cases. (Cassar-FRC)
W83-02836

SUPPLY OF A RURAL COMMUNITY IN THE RHONE DEPARTMENT BY MEANS OF MID-DEPTH DRILLING IN THE 'MOLASSE' OF THE BAS-DAUPHINE (ALIMENTATION D'UNE COMMUNE RURALE DU DEPARTMENT DU RHONE AU MOYEN D'UN FORAGE DE PROFONDEUR MOYENNE DANS LA ('MOLASSE' DU BAS-DAUPHINE),
J. Baetz, M. Clouet d'Orval, and J. Laye.
Techniques et Sciences Municipales, No 1, p 33-37, January, 1981. 2 Fig. (No English Summary).

Descriptors: *Groundwater potential, *Water supply development, *Groundwater mining, Water resources development, Sandstones, Aquifers, Groundwater quality, *France, Rhone.

Water resources for the community of Saint-Pierre-du-Chandieu, in the South of France, are somewhat limited. The community is located too far from the Rhone or other significant surface water resources to make their utilization practical. Groundwater possibilities have been investigated. In this case, it has been determined that water in the sandstone of the Bas-Dauphine would provide an important local water supply. The quality of the water in the sandstone is similar to that of local aquifers in more superficial ground, whose main drawback is the presence of nitrate concentrations near the admissible limits. Deep drilling, to a depth of between 100 and 150 meters, into the sandstone offers such advantages as ready implementation and an easy site location, but significant costs must be incurred without a certainty of finding water of sufficient quality and in sufficient quantity to justify the expense. It is suggested that in certain local and particular cases, after establishing a precise and well-researched inventory, the sandstone could be used for emergencies. However, the permanent water needs of the region must be met through the development of better structured supply and distribution systems for water from the alluvial aquifers nearer the surface. (Carroll-FRC)
W83-02845

3C. Use Of Water Of Impaired Quality

MICROBIOLOGICAL AEROSOLS FROM A FIELD-SOURCE WASTEWATER IRRIGATION SYSTEM,
Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
For primary bibliographic entry see Field 5B.
W83-02835

PRODUCTION OF ALGAL PROTEIN IN RAW SEWAGE,
National Inst. for Water Research, Pretoria (South Africa).
E. Sandbank.
Water Science and Technology, Vol 14, No 9-11, p 1562-1563, 1982. 2 Tab.

Descriptors: *Proteins, *Raw wastewater, *Water reuse, Wastewater treatment, Feeds, Algae, Irrigation, Oxidation ponds, *South Africa.

The National Institute for Water Research is studying the production and processing of microalgae in a wastewater treatment pond with the dual purpose of treating sewage for irrigation purposes and producing algae intended as a feed or as raw material for chemical products. The objectives are to optimize algal production, study the effect of predators and means to prevent them, simplify the harvesting of microalgae, and reduce the costs of production and of the dewatering and drying processes, in order to develop an integrated system for the treatment of wastewater and algal production which could be applied in developing areas. Raw sewage is roughly filtered and fed continuously to the treatment pond. The raw sewage, pond effluent and the flotation effluent of the flotation unit were analyzed for ammonia, orthophosphate, chemical oxygen demand, chlorophyll a and suspended solids. Different alternative for drying the algal float are being tested, including drum-drying, microwave equipment for pathogen destruction and sun-drying, or combinations of thermal treatment and sun-drying. Dried algae have been sucessfully used in feeding trials with warm water fish and with poultry. (Baker-FRC)
W83-02856

STATEWIDE EVALUATION OF TRACE ELEMENT ACCUMULATION FROM LONG TERM DISPOSAL OF WASTE WATER,
California Univ., Irvine.
B. H. Olson, D. C. Hill, and M. G. Rigby.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196444, Price codes: A07 in paper copy, A01 in microfiche. Completion Report, California Water Resources Center, California Univ. Davis, March 1983. 128 p, 6 Fig, 46 Tab, 125 Ref. OWRT B-207-CAL(1).

Descriptors: *Wastewater, *Wastewater disposal, *Land disposal, Water reuse, *Trace metals, *Path of pollutants, *Trace elements, *California, Water pollution sources, Soil contamination, Water quality control.

In this study twenty reuse sampling sites were selected on the basis of the following criteria: length of time the site has received wastewater, amount and manner of application, quality of wastewater applied, and the availability of historical data on trace element content in wastewater effluent. Each site was visited once during the two year study. Both soil and vegetation samples were collected from each site. These samples were analyzed for Cd, Cu, Pb, Ni and Zn content. Soil samples were also analyzed for pH, CEC and water content. Results indicated that 9% of the fields investigated showed an accumulation of trace elements from reuse practices. Metal enrichment was confined to the upper layers of soil, but penetrated into the soil column depending on soil type and rate of wastewater application. Translocation of metals into plants from these sites was dependent on the plant species as well as the given metal. Cadmium and Zn were the most mobil of the metals tested. This investigation concludes that land application of wastewater provides useful irrigation waters under most circumstances. Metal accumulation was noted only for fields which had not been ploughed. Filling the soil most likely dilutes the amount of metal in a given cm core by spreading it over the depth of tillage. Increased chances for significant elevation of soil metal occurs when the level of treatment is reduced below secondary, when the application rate is increased, or if a high percentage of wastewater is from industrial sources. (Snyder, Calif.)
W83-02892

INFILTRATION AS AFFECTED BY LONG-TERM USE OF SODIC-SALINE WATER FOR IRRIGATION,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
A. Hadas, and H. Frenkel.
Soil and Science Society of America Journal, Vol 46, No 3, p 524-530, May/June, 1982, 4 Fig, 5 Tab, 19 Ref.

Descriptors: *Infiltration rates, *Saline water, *Soil surfaces, Irrigation water, *Israel, Hydraulic

conductivity, Runoff, Cotton, Soil texture, Gypsum, Water pollution effects, Semiarid lands.

Infiltration rates were determined in cotton fields located on the southern central plain of Israel. Irrigation water was sodic-saline, EC = 5.6 mmho per cm and sodium absorption ratio of 26. The infiltration rates were in the following descending order: saline-sodic water + gypsum treatment > saline-sodic water, untreated soil > distilled water + gypsum treatment > distilled water. Fields irrigated for 8 years with the saline-sodic water had higher infiltration rates than the fields irrigated for 2 years. This was a result of the difference in crust structure. The soil surface in the field irrigated for 8 years was well cracked and underlain by a crumbly soil. This underlayer was absent in the field irrigated for only 2 years. The hydraulic conductivities of the crusts showed the same trends as the infiltration rates. The calculated hydraulic conductivities and infiltration rates for unponded conditions also followed the same trends as values for high hydraulic head. (Cassar-FRC)
W83-03016

EVALUATING POTENTIAL HEALTH RISKS OF CONSUMING REUSED WATER,
Chemical Industry Inst. of Toxicology, Research Triangle Park, NC.
For primary bibliographic entry see Field 5C.
W83-03086

3D. Conservation In Domestic and Municipal Use

WATER RECYCLING SYSTEMS,
American Water Works Association Research Foundation, Denver, CO.
R. D. Heaton.
Water Science and Technology, Vol 11, No 9-11, p 1393-1429, 1982. 27 Fig, 20 Tab, 3 Ref.

Descriptors: *Water reuse, *Wastewater treatment, Recreation demand, Irrigation, Water demand, Water management, Water supply development, Financial aspects, Decision making.

The treatment given to municipal wastewater for community reuse is determined by the intended use, institutional considerations, economics, and health considerations and quality criteria. In order to identify the most promising users in a given location the chief characteristics of all local markets for water must be considered. The following factors must be considered: who are the large water consumers; is water use characterized by wide spread domestic use or are dominant consumers evident; what domestic, industrial, agricultural or recreational water users might as well be served by reclaimed water; what factors of water use such as residential growth, irrigation needs, industrial development, are forcing new and increasingly expensive sources; and what are the volumes and cost of a user's present water supply. In order to extract potentially viable reuse schemes from literally thousands of possibilities and integrate the survey and subsequent evaluation with other interested agencies a 10-step screening process was designed as follows. List all possible types of reuse; 65 of these were identified. Compare the types of reuse to both the current and anticipated regulations of the Department of Health Services and to the experience obtained in other parts of the country. A total of over 1,000 sites was identified in the 200 sq mile area as possible locations for priority reuse applications. Of these 1,000, those that would use less than ten acre-feet per year were dropped as uneconomical. Through further refinement 18 feasible projects were identified, which included 6 industrial users, 3 agricultural users, 2 golf courses, 6 parks and 3 freshwater marshes using a combined total of more than 13,000 acre-feet per year. Various water recycling systems are cited and described as they relate to these 18 potential projects. (Baker-FRC)
W83-02878

WATER CONSERVATION KITS: A TIME SERIES ANALYSIS OF A CONSERVATION POLICY,
California Univ., Santa Barbara. Dept. of Economics.
W. D. Morgan.
Water Resources Bulletin, Vol 18, No 6, p 1039-1042, December, 1982. 2 Tab, 15 Ref.

Descriptors: *Water consumption, *Time series analysis, Water conservation, Water use, Oxnard, *California, Regression analysis, Property value.

Installation of water conservation kits in the households of a section of Oxnard, California, reduced average bimonthly water use by 3,101 cu ft or 4.2%. An estimated 62.5% of households installed some portion of the kit, which included a water guard to reduce toilet flushing water, a shower head flow restrictor, and dye tablets to detect toilet storage tank leaks. Probability of installing the kit was not related to age of resident, number of people in household, or years lived in house. Residents living in houses older than 20 yr or houses in poor condition were less likely to install the kits. The most important factor favoring the probability of installation was a high assessed value. (Cassar-FRC)
W83-03136

3E. Conservation In Industry

WATER RECYCLING: REVIEW AND BACKGROUND,
Black and Veatch, Denver, CO.
K. D. Linstedt.
Water Science and Technology, Vol 14, No 9-11, p 1385-1392, 1982. 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Water reuse, *Water demand, Water management, Wastewater treatment, Irrigation, Potable water, Water supplies, Public opinion, Financial aspects.

The world water resource situation is reviewed. Water reuse is described as a means of augmenting conventional supplies, with types of potential reuse applications cited. Water quality, cost public acceptance and institutional constraints are identified as they affect water reuse programs. While there is substantial excess runoff on a worldwide basis, the geographical distribution of precipitation and runoff is not uniform. Much of the world water resource is concentrated in land areas of relatively low population in South America, Central America, Africa, and Southeast Asia. Water reuse can be described as indirect when water from domestic or industrial sites is discharged into receiving waters and withdrawn again for a subsequent use. Direct reuse situations are those that occur as a direct result of planned and deliberate use of treated wastewater for beneficial purposes such as irrigation, industry, groundwater recharge, and potable supply. The term 'water recycling' is often used to describe internal reuse of wastewaters prior to discharge, particularly in an industrial context. Water quality considerations will vary with the intended reuse of the water. For example, an agricultural irrigation application must consider microorganisms, dissolved salts, heavy metals and suspended solids. In industrial reuse categories corrosion inhibitors, foaming agents, and nutrient content are significant. Costs vary with the degree of treatment needed and may also be significantly affected by the need to transport and distribute the water from point of treatment to the point of reuse. Public acceptance varies with the perceived level of contact that the public will have with the renovated water source. As the level of contact is reduced, acceptability of the reuse program increases. (Baker-FRC)
W83-02877

WATER RECYCLING - INDUSTRIAL APPLICATIONS,
Ruhrverband, Essen (Germany, F.R.).
D. R. Albrecht, and K. R. Imhoff.
Water Science and Technology, Vol 14, No 9-11, p 1431-1445, 1982. 11 Fig, 1 Tab, 18 Ref.

Descriptors: *Water reuse, *Water demand, *Industrial water, Water supply, Financial aspects, Industrial wastewater, Wastewater treatment, Pulp and paper industry, Pickling, Metal-finishing wastes, Sugars, Steel industry, Powerplants, Sulfite.

Industrial water recycling techniques are used in such varied industrial settings as steel production, pickling and plating, coal mining and coking, sulfite cellulose and paper production, sugar works and power plants. Special consideration is given to water recycling in metal finishing works and paper mills. Increasing water prices and effluent charges along with regional water scarcity are considerable incentives for the application of industrial water recycling systems. Depending on different production procedures various types of industrial water cycles are available. Due to the scarcity of water and the required effluent quality, at the Salzgitter steel mill the fresh water demand was lowered from 84 cubic meter/ton of steel to only 4 cubic meter/ton by water reuse. In picking and plating plants all measures of water saving must start with the rinsing process. The rinse water demand of electroplating baths can be lowered by continuous conductivity control. At paper mills, water measurement at eight important locations within the production process can result in savings. Other factors include pulp solution by recycled 'thick water' from a new substance reclamation plant, collection and recycling of cooling waters, application of non-water-sealing bushings in pumps, use of clear water from substance reclamation as spray water for paper machines, performance of consistency regulation with thick water and clear water, and the installation of two water cycles in conjunction with a filter belt at the paper machines. Sufficiently clarified water can even be recycled to the grinding plant. (Baker-FRC)
W83-02879

THE EXHAUSTIVE REUSE OF WATER IN FOOD PROCESSING,
Manitoba Univ., Winnipeg. Dept. of Food Science.
R. A. Gallop, A. W. Hydamaka, B. J. Clark, and L. B. Carvalho.
Water Science and Technology, Vol 14, No 9-11, p 1549-1550, 1982.

Descriptors: *Food processing, *Water reuse, Wastewater renovation, Water use, Water supply, Water resources development, Recycling, Industrial water, Heat transfer, Mass transfer.

The increasing need for larger and larger supplies of food dictates increasing use of recycled water in food processing. The major roles for water usage in food processing are for heat transfer and mass transfer, mostly during in-plant operations, which can be mostly made highly cyclic to great advantage. The symbiotic use of solid wastes from food plants as filter aids, as fuels, and as substrates for the on-site production of very good activated carbons is the best way to solve many problems. Skillful use of the solid wastes can permit food processing waters, especially the edible ones normally rejected as wastes, to be used as processing aids, which will greatly improve the productivity of such lines while permitting the same volume of original water to be safely used to practical exhaustion over many weeks or longer. The recovery of water from process plumes by condensation for heat recovery or from process streams can soon supply plants with more than 100% of their daily on-site water needs for makeup to the virtually closed loop total process systems now required. (Baker-FRC)
W83-02884

THE PERFORMANCE OF AN ULTRAFILTRATION PILOT-PLANT FOR THE CLOSED LOOP RECYCLING OF TEXTILE DESIZING EFFLUENTS,
Natal Univ., Durban (South Africa).
For primary bibliographic entry see Field 5D.
W83-03123

3F. Conservation In Agriculture

WATER POLICY: A CALIFORNIA SPLIT,
K. Cook.
Journal of Soil and Water Conservation, Vol 37, No 6, p 329-332, November/December, 1982.

Descriptors: *Water policy, *Water conservation, *Irrigation efficiency, Water law, *California, Legal aspects, Agriculture, Water use efficiency, Water management, Public participation.

In the November 1982 election California voters faced decisions on 15 statewide initiatives in addition to the candidates and questions of local policy. Proposition 13 was: Should our state water laws be changed to mandate conservation of surface and groundwater supplies. The vote was 35% in favor and 65% opposed. Although 87% of the state's water use is agricultural, 90% of the users are urban. The question was difficult to decide intelligently because of the complex legal implications. Much money was spent to proponents and opponents on propaganda and publicity. The appearance of the water initiative on the ballot points out the split in California water policy. Water use efficiency is 60% in California at present, greater in the south than in the north. There is room for improvement in irrigation efficiency, since many farmers apply water by a strict schedule, disregarding weather conditions and crop needs. Water prices vary from $1 to $150 per acre-foot throughout the state. Many irrigation districts structure their prices to ensure full use of their water entitlement. The recently launched California Irrigation Management Information System is designed to give scheduling information from 40 automated weather stations to aid in improving irrigation efficiency. (Cassar-FRC)
W83-02838

IS THE OGALLALA GOING DRY.
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
R. J. Supalla, R. R. Lansford, and N. R. Gollehon.
Journal of Soil and Water Conservation, Vol 37, No 6, p 310-314, November/December, 1982. 6 Tab, 7 Ref.

Descriptors: *Groundwater depletion, *Aquifers, *Water shortage, *Ogallala Aquifer, Groundwater availability, High Plains Study, Economic aspects, Cost analysis, Agriculture, Farming, Dry farmig, Water management, Water policy, Water supply, Planning, Water transfer, Water table decline, Groundwater management, Water conservation.

Concern over diminishing water supplies from the Ogallala Aquifer initiated the High Plains Study, authorized by Congress in 1976. It concluded that groundwater shortages are not present in the six-state region except in localized areas. Although different analysts could reach different conclusions from the results of the study, this paper agrees with the statement that problems in agricultural production or economic viability are confined to some areas of some states. Education and research on dryland agriculture and programs designed to attract nonwater-intensive industry will probably be the best long-term solutions to the problems. Mandatory pumping restrictions would extend the aquifer life at an unacceptably high economic cost; this should only be applied in local problem areas affected by groundwater exhaustion. Large intrastate and interstate water supply augmentation projects, considered only for Oklahoma and Nebraska, will not be economically feasible for at least the next 40 years, if ever. Costs of delivering water by large scale transfer would be up to 10 times the irrigation benefits. (Cassar-FRC)
W83-02839

WATER RECYCLING: REVIEW AND BACKGROUND,
Black and Veatch, Denver, CO.
For primary bibliographic entry see Field 3E.
W83-02877

WATER REQUIREMENTS FOR FLOODED RICE CULTIVATION,
Binnie and Partners, London (England).
W. M. Clark, M. E. Bramley, and R. F. Thorp.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 73, No 4, p 769-788, December, 1982. 7 Fig, 3 Tab, 16 Ref.

Descriptors: *Rice, *Irrigation efficiency, *Water requirements, Crop growth, Scheduling, Water conservation, Humid climates, *Indonesia.

This paper addresses the practical aspects of calculating water requirements for rice cultivation. Many previous methods have not considered local farming and operating requirements and have concentrated on maximum area of irrigation rather than maximum rice production. Peak water demands occur during presaturation, which is the initial stage of land preparation for transplanting. Most existing formulas use a 14-21 day presaturation period, whereas a minimum of 28 days is seen in practice for individual farms. A scheme is presented for determining the water requirements of this presaturation period based on soil saturation, depth of desired water layer, evaporation, percolation, and duration of the presaturation period. Water requirements for the period of crop growth are obtained with standard methods for other crops, also considering some problems unique to flooded rice. The gongolan (group) arrangement used in Indonesia is a water scheduling arrangement in which water from the primary canal is divided into three secondary canals, supplying water to subunits. Several schemes of water application are possible. These involve combinations of several factors: different starting dates, cropping intensity, and continuous or rotational irrigation. (Cassar-FRC)
W83-03002

GROUNDWATER RESOURCES IN THE JUAREZ-EL PASO REGION (DE AGUAS SUBTERRANEAS EN LA REGION DE JUAREZ-EL PASO),
Escuela Superior de Agricultura Hermanos Escobar, Chihuahua (Mexico). Area de Manejo de Agua y Suelo.
For primary bibliographic entry see Field 2F.
W83-03020

IRRIGATION WATER MANAGEMENT FOR WIDE-SPACED FURROW IRRIGATION,
Oklahoma State Univ., Stillwater. Dept. of Agronomy.
J. F. Stone, M. E. Hodges, J. E. Garton, and H. E. Reeves.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206847, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Oklahoma State Univ., Stillwater, March 1983. 22 p, 2 Fig, 4 Tab, 11 Ref. OWRT A-090-OKLA(2), 14-34-0001-1138.

Descriptors: *Irrigation design, *Surface irrigation, *Water conservation, *Water management, Agricultural hydrology, Conservation, Groundwater irrigation, Irrigation, Irrigation practices, Soil water, Varied flow, Water requirements, *Oklahoma, *Furrow irrigation, Sorghum, *Irrigation scheduling.

The study was conducted at the Panhandle Research Station at Goodwell, Oklahoma. Two furrow spacings were studied in the production of bedded grain sorghum. Rows were 1/2 mile long. Two rows of grain sorghum were planted on each bed, with bed and furrow spacing of 56 in. The wide-spaced furrow irrigation was accomplished by irrigating alternate furrows, making the spacing 112 in. A replicated design was employed. Soil water content was measured at points approximately 50, 700, 1400, and 2000 ft. from the point of water application. Irrigation was scheduled for 14-day intervals, with portable H-flumes to set the flow rates. Problems with irrigation wells caused the application periods to be far longer, making the yield management and water savings portion of the study unrealistic. However, the portion of the study dealing with examining methods to apply water uniformly to the field with long rows was successful. The rates of advance of water in the wide-spaced furrows and the every-furrow irrigation were equally variable for the soils and slopes of this study. When furrow streams in the wide-spaced furrow plots were adjusted to advance through the field at the same rate as the every-furrow irrigation plots, the depth of penetration of water was uniform and nearly equal for the entire length of furrow. By noting how much faster water advances through a field when using every-furrow in contrast to wide-space furrow irrigation, one can proportionally adjust the furrow stream of the wide-spaced treatment to achieve application of water equally uniformly under both treatments. Such measurements of rate of advance can be made at the start of irrigation if the field is uniform in type and slope. Longer sets and measurements did not add sufficient information to be worthwhile.
W83-03037

WATER MANAGEMENT AND SALINITY CONTROL IN IRRIGATED SWELLING AND SHRINKING SOILS,
Oklahoma State Univ., Stillwater. Research Foundation Electronics Lab.
D. L. Nofziger, J. R. Williams, and P. Hemyari.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206854, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Oklahoma State Univ., Stillwater, March, 1983. 33 p, 11 Fig, 8 Ref, 2 Append. OWRT B-053-OKLA(1), 14-34-0001-0244.

Descriptors: *Irrigation practices, *Expansive soils, *Salinity control, *Crop yield, *Furrow irrigation, Resistivity, Water use efficiency, Unsaturated flow, Hydraulic conductivity, Soil water, *Oklahoma, *Soil salinity.

The influence of different irrigation management systems on crop production, water-use efficiency, and soil salinity was investigated for swelling and shrinking soil in southwestern Oklahoma. Crop production increased significantly each year as the amount of irrigation water increased. Irrigation water-use efficiency decreased as the amount of water increased. No differences in salinity due to irrigation treatments were detected but salinity decreased over time for all treatments. Water content and potential measurements indicated that little irrigation water moved below the 30-cm depth. Therefore, little leaching occurred during the irrigation season. A field resistivity probe was developed and calibrated to facilitate the future monitoring of soil salinity. The unsaturated hydraulic conductivity of this soil was measured in situ at 5 locations. These results are presented. Soil salanity was determined before and after applying 30 to 45 cm of water to each plot. Large salinity decreases were observed to depths of 60 cm in these plots. More research will be needed to evaluate this practice on a field scale.
W83-03038

FIELD TESTS UNDERWQY FOR THREE NEW AGRICULTURAL POLYMERS.
World Water, Vol 5, No 8, p 38-39, August, 1982. 2 Fig.

Descriptors: *Soil treatment, *Arid lands, *Irrigation, Sand, *Polymers, Agriculture, Plant growth, Water conservation, Agrosoke, Soil surfaces, Soil stabilization.

Chemical soil conditioners have improved plant growth during field trials in several arid regions. The polymeric products include Agrosoke, which absorbs up to 30 times its original weight in water for later absorption by plant roots; Agrosoke Erosel, a soil surface stabilizer; and Agrosoke Bintex, a spray-on binding agent for the soil surface. Although costs of these chemicals are high, they can be economically used where irrigation water is expensive. The chemicals can be useful, not only in growing crops, but in desert reclamation, protection of seashores and river banks, drainage channels, and irrigation channels. In an Abu Dhabi landscaping pilot study about $150 per week

in water costs was saved per 100 sg m treated soil. (Cassar-FRC)
W83-03129

URUGUAY'S SAVE OUR SOILS CAMPAIGN.
For primary bibliographic entry see Field 4D.
W83-03134

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

REPRODUCTIVELY LIMITED GRASS CARP FOR BIOLOGICAL CONTROL OF AQUATIC WEEDS--BROODSTOCK PRODUCTION AND TESTING,
Alabama Cooperative Fishery Research Unit, Auburn.
W. L. Shelton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196501. Water Resources Research Institute Completion Report, Auburn Univ., Alabama, April 1983, 41 p, 4 Fig, 14 Tab, 57 Ref. OWRT A-088-ALA(1), OWP 14-34-0001-2101.

Descriptors: *Carp, *Commerical fish, *Aquatic weed control, *Fish repoduction, Gonads, Sterility, Breeding, Grass carp, Macrophytes, *Biocontrol, Fish stocking.

The Chinese grass carp eats tremendous quantities of macrophytes and is thus a potentially valuable biological means of combating the escalating aquatic weed problem in the U.S., but stocking this exotic fish has not been widely accepted because of the fear of ecological repercussions should spawning and naturalization occur. The present approach to control unwanted reproduction has been to sex reverse female grass carp into functional males and use then in a breeding program that should produce only females which could be used in stocking for weed control. The two previous phases of this long-term study described the critical period of gonadal differentiation and developed an effective system for delivering the sex-reversing hormone and accomplished initial progeny testing to validate the basic hypothesis. During the last year, the sex-reversal treatment was more clearly defined by determining appropriate stocking rate limits during hormone delivery. It was found that sex reversal can be effected at stocking densities as high as 14,000 per hectare. Progeny tests of two year classes has confirmed the production of only females in the offspring of eight sex-reversed males (genetic females); 1,166 offspring were sexed from these two year classes. A third year class was produced and will provide additional data to test the basic hypothesis. Finally, treatment was initiated to develop replacement sex-reversed male broodstock for future use; the best available treatment regime was used to develop this group of potential broodstock. Limited numbers of monosex progeny have been stocked for actual management and additional utilization is anticipated.
W83-02898

MANAGEMENT OF EXISTING RESERVOIR SYSTEMS BY INTERACTIVE OPTIMIZATION,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 6A.
W83-02924

INCREMENTAL DYNAMIC PROGRAMMING MAY YIELD NONOPTIMAL SOLUTIONS,
Hydro-Quebec, Varennes.
A. Turgeon.
Water Resources Research, Vol 18, No 6, p 1599-1604, December, 1982. 9 Fig, 3 Tab, 4 Ref.

Descriptors: *Dynamic programming, *Model studies, *Optimization, Reservoir operation.

Incremental dynamic programming, a procedure that permits the memory requirement of dynamic programming to be reduced, is widely used in water resources research. In some cases this method may produce a nonoptimal solution if the same state increment is used for every stage. A sample problem attempts to determine the maximum amount of water in storage in a reservoir at the beginning of each week, given that the river flow at a certain site must not exceed a given value. By changing the increment sizes in each stage, the desired results are obtained. (Cassar-FRC)
W83-02941

TECHNIQUES FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS IN SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 2E.
W83-02979

STORAGE REQUIREMENTS TO SUSTAIN GROSS RESERVOIR OUTFLOW FROM SMALL BASINS IN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W83-02992

THE EFFECT OF TURFGRASS THATCH ON WATER INFILTRATION RATES,
Minnesota Univ., St. Paul. Dept. of Horticultural Science and Landscape Architecture.
D. H. Taylor, and G. R. Blake.
Soil Science Society of America Journal, Vol 46, No 3, p 616-619, May/June, 1982. 2 Fig, 5 Tab, 4 Ref.

Descriptors: *Infiltration rate, *Grasses, *Soil surface, Turf grasses, Thatch, Golf courses, Organic matter.

The effect of a thatch layer on water infiltration rate in athletic turfgrass areas was studied in laboratory packed sand colums and in field tests at 9 high-sand locations, including golf greens, a football field, and roof gardens, Thatch did not restrict the flow of water into the sand after an initial wetting period of about 10 min. Average time for the first 2 cm of water to infiltrate into sand with no thatch was 0.36 min and with dry thatch, 6.34 min. After the steady state was reached, the time for infiltration of 2 cm of water was 1.7-1.8 min. The equilibrium infiltration rates were not affected by packing the thatch or packing the sand surface. However, loosening the sand surface increased infiltration rates with and without thatch. In the field tests removal of the thatch layer did not significantly change the infiltration rates in 6 locations. At the other three sites infiltration rates decreased, possibly as a result of pore plugging or air entrapment in the soil samples. (Cassar-FRC)
W83-03023

OVERLAND FLOW FROM SLOPING LAND: EFFECTS OF PERCHED WATER TABLES AND SUBSURFACE DRAINS,
Oregon State Univ., Corvallis. Agricultural Experiment Station.
B. Lowery, G. F. Kling, and J. A. Vomocil.
Soil Science Society of America Journal, Vol 46, No 1, p 93-99, January/February, 1982. 3 Fig, 5 Tab, 18 Ref.

Descriptors: *Water table fluctations, *Seepage control, *Overland flow, *Perched water table, *Surface sealing, Subsurface drainage, Watersheds, Water management, Rainfall intensity, Antecedent moisture, *Hydraulic conductivity, Runoff, Drainage effects, Slopes, Willamette Valley, *Oregon.

The cause of overland flow from sloping fallplanted agricultural watersheds in the Willamette Valley, Oregon, foothills was ephemeral perched water tables, high antecedent soil moisture levels, and seepage zones. A minor amount of overland flow resulted from soil surface sealing and freezing. The temporary perched water tables developed because of restrictive layers in the soil and from heavy storms. The water table was nearer the ground surface at lower landscape positions than at the hilltops. Subsurface drains installed in a 1.4 ha watershed eliminated seepage areas, reduced the occurrences of the ephemeral perched water tables, and eliminated baseflow. Overland flow continued to occur after some storm events with high rainfall intensity or long duration, especially if antecedent moisture was high. The drains were particularly effective in reducing runoff in early winter before growth of the vegetative cover. (Cassar-FRC)
W83-03028

BIOLOGICAL AND RECREATIONAL ASPECTS OF WATER LEVEL MANAGEMENT FOR CLEAR LAKE, IOWA,
Iowa State Univ., Ames. Dept. of Animal Ecology.
For primary bibliographic entry see Field 6G.
W83-03036

EVALUATION OF RAPID RESERVOIR STORAGE-YIELD PROCEDURES,
Victoria State Rivers and Water Supply Commission, Armadale (Australia).
C. H. Teoh, and T. A. McMahon.
Advances in Water Resources, Vol 5, No 4, p 208-216, December, 1982. 9 Fig, 3 Tab, 16 Ref.

Descriptors: *Reservoir storage, *Mathematical equations, *Design criteria, *Evaluation, Water supply, Water management, Water storage, Storage, Reservoirs, Water supply development, Construction, Australia, Malaysia.

Rapid storage-yield procedures were reviewed and evaluated by a theoretical examination of each procedure and by application of each procedure to selected streams. The eight procedures studied were Hurst (empirical), Alexander (gamma), Gould (synthetic), Dincer, Gould (gamma), Hardison (carryover), and Guglij and McMahon (empirical). Each procedure was applied to 3 Australian and 12 Malaysian stream s. The storage estimates determined from the rapid procedures were compared with those from behavior (or simulaton) analysis and Gould's transition matrix method. Limitations in theoretical models result from the basic assumptions upon which they were developed. For empirical models, difficulties arise through the non-representativeness of the basic data. Some procedures are restricted in the range of conditions within which they are applicable. The results indicate that Gould's (gamma) and McMahon's (empirical) procedures provide satisfactory storage estimates for preliminary assessments. Both these procedures are recommended for use during preliminary design. However, because insufficient independent testing was carried out, the latter method should be restricted in application to Australian and Malaysian streams. Alexander's (gamma) and Hardison's (carryover) procedures are acceptable, though not recommended for determining storage estimates for preliminary design purposes. Hurst's (empirical), Gould's (synthetic), Guglij's and Dincer's procedures are generally unsatisfactory. They are either limited by theoretical assumptions and/or restricted by the range of conditions within which they are acceptable. (Baker-FRC)
W83-03061

OPTIMAL ANNUAL OPERATION OF A WATER SUPPLY AND DISTRIBUTION SYSTEM,
Mekoroth Water Co., Haifa (Israel).
For primary bibliographic entry see Field 6A.
W83-03062

METHODS FOR DERIVING OPERATING RULE CURVES FOR MULTIPLE RESERVOIR SYSTEMS,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
D. P. Loucks, and J. R. Stedinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208330,

Price codes: A03 in paper copy, A01 in microfiche. Completion Report, March 1983. 20 p, 3 Fig, 4 Tab, 24 Ref. OWRT B-094-NY(1), 14-34-0001-1250.

Descriptors: *Reservoir management, *Reservoir operations, *Risk, Hydropower, Reliability, Optimization, Linear programming, Linear-decision-rules, Reservoir design, Algorithms, *Optimal development plans, Decision making, Resiliency, Vulnerability.

Studies undertaken examined procedures to improve the efficiency with which reservoir systems are operated and to improve the tools for studying such systems. Three risk-based criteria (reliability, resiliency and vulnerability) for describing reservoir system operation were developed. These criteria illustrated the sensitivity of a reservoir system's performance to the objective function employed to derive its operating policy. Several families of multi-reservoir screening models were examined. Models based on mean-monthly flows performed very poorly as did linear-decision-rule (LDR) chance constrained models. The latter, which have been proposed as simple reservoir screening models and used to derive reservoir operating policies, were found to be of questionable value for screening models and used to derive reservoir operating policies, were found to be of questionable value for screening purposes in water supply problems with flood storage constraints; likewise, they were shown to generate very inefficient operating policies. Finally, three algorithms for optimizing the operation of multireservoir hydropower systems with a deterministic flow forecast were developed and compared. A sequential linear programming (SLP) approach always found the optimal solution in somewhat less time than an improved version of Becker and Yeh's linear-dynamic programming model. A new optimal control algorithm was faster than the SLP procedure but is difficult to implement.
W83-03094

4B. Groundwater Management

GEOTHERMAL RESOURCES IN THE BANBURY HOT SPRINGS AREA, TWIN FALLS COUNTY, IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W83-02972

GEOLOGIC AND WELL-CONSTRUCTION DATA FOR THE H-7 BOREHOLE COMPLEX NEAR THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Fenix and Scisson, Inc., Tulsa, OK.
S. L. Drellack, Jr, and J. G. Wells.
Available from the National Technical Information Service, Springfield, VA 22161. Geological Survey Water-Resources Investigations 82-38, April 1982. 25 p, 2 Fig, 1 plate, 7 Tab, 11 Ref.

Descriptors: *Cores, *Boreholes, *Radioactive waste disposal, *Core drilling, Geologic units, Drillers logs, Data collections, Groundwater movement, *New Mexico, Waste Isolation Pilot Plant.

The H-7 borehole complex, a group of three closely spaced boreholes, is located two miles southwest of the proposed Waste Isolation Pilot Plant site in east-central Eddy County, New Mexico. The holes were drilled during September and October 1979 to obtain geologic and hydrologic data to better define the regional ground-water-flow system. The geologic data presented in this report are part of a site-characterization study for the possible storage of defense-associated radioactive wastes within salt beds of the Salado Formation of Permian age. The geologic data include detailed descriptions of cores, cuttings, and geophysical logs. (USGS)
W83-02977

AQUIFER TEST RESULTS, GREEN SWAMP AREA, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W83-02980

EVAPOTRANSPIRATION OF APPLIED WATER, CENTRAL VALLEY, CALIFORNIA, 1957-78,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2D.
W83-02984

GEOLOGY AND GROUND-WATER RESOURCES OF OSWEGO COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W83-02987

GROUND-WATER RESOURCES OF THE ARCADIA-MINDEN AREA, LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W83-02991

HYDROLOGIC DATA OF THE LOWER MERRIMACK RIVER BASIN, MASSACHUSETTS, FROM CONCORD RIVER, LOWELL, TO PLUM ISLAND, NEWBURYPORT,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W83-02994

ASSESSMENT OF ECONOMIC, SOCIAL, AND INSTITUTIONAL IMPACTS OF GROUNDWATER REGULATION OF THE TILLMAN TERRACE AQUIFER IN SOUTHWESTERN OKLAHOMA,
Oklahoma State Univ., Stillwater. Dept. of Geology.
D. C. Kent, H. P. Mapp, and J. W. Westphal.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206805, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Oklahoma State Univ., Stillwater, March 1983. 210 p, 22 Fig, 74 Tab, 6 Append. OWRT A-093-OKLA(2), 14-34-0001-0138.

Descriptors: *Groundwater irrigation, *Economic prediction, *Linear programming, *Numerical analysis, *Public opinion, *Political aspects, Computer models, Groundwater management, Water law, Social impact, Economic impact, Model studies, *Oklahoma, Tillman Terrace aquifer.

The purpose of this project is to assess the economic, polital, legal and social impacts of groundwater regulation in Tillman County, Oklahoma. The assessment makes use of a mathematical model developed for the computer by the U.S. Geological Survey and modified for use as a means to determine the amount of ground-water allocation from the Tillman Terrace aquifer in Oklahoma. Interpretation of ground-water law in Oklahoma is used as the basis for determining model design scenarios. Two scenarios are considered: (1) existing pumping projected to 1993 and (2) additional pumping after 1983. A constant annual pumping rate of 1 ac ft/ac, which is based on the current ground-water allocation, is used for both scenarios. Results of the aquifer model simulation runs for the two scenarios are used in a separate economic linear optimization model in order to consider economic impact of aquifer depletion between 1983 and 1993. Irrigated and dryland crop patterns and commodity prices are used in conjunction with the model prediction of water levels and well yield. Social implications related to ground-water depletion between 1983 and 1993 are based on field surveys and results of the economic analysis. An assessment is also made for the legal and institutional constraints needed to regulate and manage the aquifer with respect to economic predictions in the study.
W83-03033

USE OF GEOLOGIC AND WATER YIELD DATA FROM GROUND WATER BASED COMMUNITY WATER SYSTEMS AS A GUIDE FOR GROUND WATER PLANNING AND MANAGEMENT,
North Carolina State Univ. at Raleigh. Dept. of Marine, Earth and Atmospheric Sciences.
C. W. Welby, and T. M. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208314, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 184, North Carolina State Univ., Raleigh, August 1982. 111 p, 16 Fig, 21 Tab, 37 Ref, 4 Append. OWRT A-120-NC(1), 14-34-0001-1135.

Descriptors: *Well Yield, *Geohydrology, *Groundwater availability, *Groundwater management, Specific capacity, Geologic fractures, Crystalline rocks, Petrology, Low flow, Groundwater recharge, Stream discharge, Land use, Topography, *North Carolina, Wake County, Data collections, Well data.

Data from 214 wells in the Community Well System of Wake County, North Carolina provided information on groundwater availability that should be valuable in land-use planning. Well yield data are used to identify favorable and unfavorable areas for groundwater development, and probability curves are used to estimate yields of wells in a given rock type. A two-media system was recognized, consisting of the saprolite and the fractured crystalline bedrock. Characteristics of the fracture system (frequency, size and interconnection) are the most important variables affecting well production. Lithology is the second most important factor. The highest average yield occurs in wells in the injected gneiss and schist, the lowest average yield in mica gneiss and schist, and intermediate yields in granite and in felsic gneiss and in felsic gneiss and schist. Specific capacity was found to be a better parameter than yield for comparing the water bearing capacities of individual well sites. Low stream flow values (7-day, 10-year; 7-day, 1-year) are used to estimate usable groundwater recharge. Planning considerations are discussed, as are reasons for well failures.
W83-03046

WELL RECHARGE IN IDEALIZED RECTANGULAR AQUIFERS,
Thessaloniki Univ., Salonika (Greece). Dept. of Hydraulics.
P. Latinopoulos.
Advances in Water Resources, Vol 5, No 4, p 233-235, December, 1982. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Aquifer recharge, *Recharge wells, *Mathematical equations, Aquifer characteristics, Aquifers, Wells.

Analytical solutions for groundwater flow in rectangular aquifers are presented in the case of a single well recharge. The problem concerns the impact of a seasonal recharge scheme of variable duration on aquifers with various boundary conditions. The results obtained from these idealized aquifers can be used in a preliminary assessment of the groundwater response to artificial recharge schemes. Among the goals of an artificial recharge scheme is storage augmentation and river regulation, for example, low flow supplementation. Since the natural inputs and outputs of an aquifer vary seasonally, the efficient way of using artificial recharge should be such that deficiencies during the dry period of a year could be beneficially supplemented from surplus water added artificially during the wet period. However, the dry and wet periods are repeated almost consecutively year after year, so a reasonable approach to operating any recharge system is to run it under an annual periodicity. The flow is assumed to take place through an idealized aquifer, rectangular in shape, which is non-leaky, homogeneous with respect to storage, and homogeneous and isotopic with respect to transmissivity. The analytical solutions for

the two-dimensional aquifer recharge are of great help in deriving prelimimary estimates of the future consequences from artificial recharge schemes. (Baker-FRC)
W83-03056

OPENING OF A FAULT AND RESULTING SLIP DUE TO INJECTION OF FLUID FOR THE EXTRACTION OF GEOTHERMAL HEAT,
Tohoku Univ., Sendai (Japan). Dept. of Mechanical Engineering.
K. Hayashi, and H. Abe.
Journal of Geophysical Research, Vol 87, No B2, p 1049-1054, February 10, 1982. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Geothermal studies, *Injection, *Hydraulic fracturing, Geologic fissures, Thermal water, Model studies, Heat flow, Friction.

A reservoir filled with heat exchange fluid is necessary to extract heat from hot dry rock masses. The behavior of a fault with a fluid-filled region is studied by mathematical models. The fault is described as a prefractured plane in the earth's crust and is modeled by an interface across which two elastic bodies contact each other, where frictional forces against the relative movement between the two surfaces of the interface are considered. When fluid is injected between the surfaces, the fault opens up in the region where the pressure acting on the fault plane before the injection is locally smaller than that on neighboring regions. The slip of surfaces caused by reduction of frictional forces due to fluid injection is analyzed by two models: an interface with frictional resistance only and an interface with both frictional resistance and fracture toughness. The size of the slipped region was not significantly different from the dimensions of practical interest. (Cassar-FRC)
W83-03132

APPLICATION OF LINEAR SYSTEMS THEORY AND LINEAR PROGRAMMING TO GROUND WATER MANAGEMENT IN KANSAS,
Kansas State Geological Survey, Lawrence.
M. Heidari.
Water Resources Bulletin, Vol 18, No 6, p 1003-1012, December, 1982. 5 Fig, 2 Tab, 20 Ref.

Descriptors: *Groundwater management, *Wells, *Pumpage, Model studies, Pawnee Valley, *Kansas, Linear Systems Theory, Linear programming, Water table, Appropriation.

A groundwater management model based on the use of linear systems theory and linear programming has been developed. It can calculate the best pumpage policies subject to physical and institutional constraints. The validated model is applied to the Pawneee Valley, Kansas, region, using 61 hypothetical well fields for 2 periods, 5 or 10 years. For the 5-year period, 2 types of optimal pumpage policies are generated: with and without net appropriation as a constraint. For the 10-year period, 2-year optimal pumpage policies are generated using 25% of the saturated thickness without net appropriation as a constraint. About 50% of the 1979 net appropriation may be satisfied (32,318 acre ft per year). This study concludes that the groundwater resources of the Pawnee Valley are highly overappropriated. There seems to be no possibility that the 1979 net appropriation of 64,018 acre ft may be pumped from the aquifer for a long time. At best 40,000-50,000 acre ft per year may be pumped in 5 years and 30,000-35,000 acre ft per year may be pumped over the next 10 years if 25% of the saturated thickness is allowed to be used up. (Cassar-FRC)
W83-03142

4C. Effects On Water Of Man's Non-Water Activities

CHANGES IN MARSH AREA ALONG THE CANADIAN SHORE OF LAKE ONTARIO,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
T. H. Whillans.
Journal of Great Lakes Research, Vol 8, No 3, p 570-577, 1982. 6 Fig, 2 Tab, 29 Ref.

Descriptors: *Marshes, *Maps, *Urbanization, Wetlands, *Lake Ontario, Shores, Coastal marshes, Land development, *Canada.

Losses of marsh area were studied on the Canadian shoreline of Lake Ontario from the Bay of Quinet west to the Niagara River. Maps dated 1789 to 1962 established a baseline marsh area of 11,138 acres. Net losses for 62 marshes were estimated at 4745 acres or 43% of the baseline area, as determined by comparison with 1977-79 maas. Losses were highest in heavily settled areas such as Toronto (York County), and Peel, Wentworth, and Niagara Counties. In the eastern section of the studied shoreline losses were 4-27%. The method has some difficulties which limit its usefulness: lack of standardization, a focus on emergent vegetation, and difficulties in interpreting old maps. However, it is suitable for rough approximations and for use with other methods. (Cassar-FRC)
W83-03076

THE IMPACT OF ENERGY DEVELOPMENT IN THE TONGUE RIVER BASIN, SOUTHEASTERN MONTANA,
Ohio Wesleyan Univ., Delaware. Dept. of Geography and Geology.
D. H. Hickcox.
Water Resources Bulletin, Vol 18, No 6, p 941-948, December, 1982. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Coal mining, *Groundwater pollution, *Water allocation, Mine drainage, Strip mines, Tongue River, *Montana, Water quality, Water level, Wells, Aquifers, Water pollution sources, Water rights, Energy.

Rapid development of coal deposits in Montana's Tongue River Basin has significantly affected the hydrologic systems in the region. The 150 mi long, 50 mi wide basin currently has four coal mines, including the Decker Coal Company, one of the largest in the U.S. There, mining is concentrated on a 53-ft thick seam of subbutuminous coal, which is strip mined. The mine cut intercepts the aquifer and has stimulated lateral groundwater flow toward the mine and vertical flow from a coal bed to an overlying coal bed. Groundwater flow is now from the Tongue River reservoir toward the mine. Well levels have declined > 20 ft within 3/4 mile, 10 ft within 1.75 mile southwest of the mine, and 10 ft 1.5 mile northwest of the mine. By 1974 the rate of decline diminished, suggesting that systems were approaching equilibrium. Mine spoil leachates have increased levels of sodium, bicarbonate, and sulfate in groundwater. Surface water guality has also degenerated. Higher levels of dissolved solids and suspended sediments are apparent. Present water allocation favors agriculture, municipalities, and instream uses. Future coal mine development in this area may be constrained by water supplies. (Cassar-FRC)
W83-03139

4D. Watershed Protection

SOIL CONSERVATION IN THE COON CREEK BASIN, WISCONSIN,
California Univ., Los Angeles. Dept. of Geography.
S. W. Trimble, and S. W. Lund.
Journal of Soil and Water Conservation, Vol 37, No 6, p 355-356, November/December, 1982. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Soil conservation, *Erosion control, *Sedimentation rates, Soil management, Soil erosion, Cook Creek, *Wisconsin, Land management, Land use, Conservation.

Soil conservation measures appeared to be responsible for the significant declines in erosion and sedimentation rates from 1934 to 1975 in the Coon Creek Basin, Wisconsin. Average annual erosion rates on upland fields, computed from the Universal Soil Loss Equation, were 3000 metric tons per sq km in 1934 and 720 metric tons per sq km in 1975. Annual sedimentation rates, as determined by accumulation rates in small reservoirs, were 4800 metric tons per sq km of drainage area in 1936-45 and 55 metric tons per sq km in 1962-75. Sedimentation rates determined by deposition rates in the main valley were similar. Erosion and sedimentation were functions of erosive land use, an index of land use and land treatment, but there was a time lag of 10 to 40 years, increasing downstream. Although the total crop acreage did not change greatly over the years, conservation practices improved. These included contour plowing, contour stripcropping, long ratation, crop residue management, cover crops, improved fertilization, and controlled grazing. (Cassar-FRC)
W83-02827

SHORE PROTECTION IN THE TOWN OF STONEY CREEK, SOUTHWEST LAKE ONTARIO, 1934-1979: HISTORICAL CHANGES AND DURABILITY OF STRUCTURES,
Guelph Univ. (Ontario). Dept. of Geography.
R. G. D. Davidson-Arnott, and H. I. Keizer.
Journal of Great Lakes Research, Vol 8, No 4, p 6350647, 1982. 10 Fig, 1 Tab, 12 Ref.

Descriptors: *Shoreline protection, *Lake shores, *Erosion control, Groynes, Sea walls, Protection, Water level fluctuations, Stoney Creek, Ontario, *Lake Ontario, Rubble, Construction, Beach erosion, Wave action.

Shore protection measures used by private property owners were studied in a 10 km stretch of shoreline at Stoney Creek on western Lake Ontario. Average rates of recession are > 1 m per year in the silty-clay till. Between 1934 and 1979 the proportion of protected shoreline increased from 20% to 64% (from 58 to 388 structures). About 60% of properties are protected by seawalls and/or groynes. Groynes of various materials were more popular before 1972, and concrete seawalls were more popular before 1972, and concrete seawalls were more popular after that date. An average of 71% of structures are damaged or destroyed within 10 years of construction and 87% within 20 years. Groynes have been slightly more durable than seawalls and rubble. The general low durability is a result of poor design and construction of the structures, lack of cooperation among property owners, and unsuitable physical factors such as high waves driven by northeast storms. During periods of low lake levels (1954-65) destruction of property and building of protective structures were considerably less than in higher water periods such as 1972-74, when 43% of all structures were damaged or destroyed each year. The economic benefit of shore protection measures in this community are questionable. Effective remedial measures would be very expensive. Although it is possible to increase the effectiveness and durability of protective structures, the scenic and recreational quality of the shoreline would be adversely affected. The problem of easily eroded till increases the difficulties of a structural solution to the erosion problem. (Cassar-FRC)
W83-02842

HYDROLOGICAL AND ENVIRONMENTAL CONTROLS ON WATER MANAGEMENT IN SEMIARID URBAN AREAS -- PHASE II,
Arizona Water Resources Research Center, Tucson.
S. D. Resnick, K. J. DeCook, and R. A. Phillips.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-202382, Price codes: A16 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, March 1983. 355 p, 58 Fig, 64 Tab, 58 Ref, 5 Append. OWRT B-023-ARIZ(7), 14-34-0001-3556.

Descriptors: *Urbanization, *Semi-arid areas, *Rainfall-runoff relationships, Water quantity, Water quality, Rainfall, *Storm runoff, Economic feasibility, artifical recharge, Water resources planning, Urban watersheds, *Arizona, Tucson, Institutional constraints, Legal aspects, Social aspects.

Rainfall and runoff studies initiated by the University of Arizona provide data for three small urban watersheds from 1968 and one rural watershed from 1957 to 1969. Annual precipitation of about 11 inches produces annual runoff ranging from 0.44 inches in depth for the rural watershed and 1.10 to 2.10 inches for the urban watersheds. There is about a four to five-fold increase in average yearly storm runoff volume with unbanization in the Tucson area. Water samples collected on a lumped basis show generally high concentrations of suspended sediment, bacterial loading, and dissolved organics. Initial field treatment and exploratory laboratory studies of treatment methods indicate that three days is an optimal length of concentrations. Multi-purpose urban storm runoff management systems can be developed to control floods while at the same time maintaining water-based linear parks along minor stream channels in semiarid regions. Multi-purpose systems are more economical than the single-purpose systems required to accomplish the same purposes. Further studies are needed to characterize the quality of storm runoff from selected urban land use areas with a view toward on-site control and disposal.
W83-02918

OVERLAND FLOW FROM SLOPING LAND: EFFECTS OF PERCHED WATER TABLES AND SUBSURFACE DRAINS,
Oregon State Univ., Corvallis. Agricultural Experiment Station.
For primary bibliographic entry see Field 4A.
W83-03028

EFFECTS OF FARMING PRACTICES ON SEDIMENT IN IRRIGATION RETURN FLOW,
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
L. G. King, and A. C. Janke.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206862, Price codes: A06 in paper copy, A01 in microfiche. Water Research Center Completion Report, Washington State Univ., Pullman, March 1983. 91 p, 8 Fig, 11 Tab, 23 Ref, 1 Append. OWRT B-067-WASH(2), 14-34-0001-7197

Descriptors: *Irrigation return flow, Irrigation tailwater, Sediment, Sediment basins, Furrow irrigation, Irrigation efficiency, *Washington, Soil erosion, Sulphur Creek drainage basin, Cultivation.

The overall objective of the research was to assist in determining the success of the Sulphur Creek Demonstration Project in reducing sediment in irrigation return flow by changing farming practices on irrigated lands. Although this demonstration project was terminated prematurely by the agencies conducting it, some valuable results were obtained. It was determined that a small percentage of irrigators cause a large fraction of the sediment content of irrigation return flows. For fourteen different sites, only three in 1977 and four in 1978 had net seasonal sediment loss in excess of 3 tons/acre. Studies of field performance of sediment basins gave valuable information on the particle size distributions of sediment in irrigation tailwater and the load of sediment carried by tailwater under various field and crop conditions. These latter two types of data are almost non-existent and yet very necessary for proper design of sediment basins. Procedures were developed and tested to provide irrigators with tools for evaluation of their irrigation practices. If properly applied, these procedures can determine whether for given field conditions, changes in water management to control sediment discharge are possible or whether a change in the irrigation system is necessary.
W83-03039

SEDIMENTATION AND ITS CONTROL IN NADIS IN THE INDIAN ARID ZONE - A CASE STUDY,
Central Arid Zone Research Inst., Jodhpur (India).
For primary bibliographic entry see Field 2J.
W83-03133

URUGUAY'S SAVE OUR SOILS CAMPAIGN.
World Water, Vol 5, No 8, p 22-23, 25, August, 1982.

Descriptors: *Erosion, *Soil management, *Uruguay, Agriculture, *Soil erosion, Soil water, Water management, Irrigation, Soil conservation, Erosion control.

Improved water and soil management practices are being encouraged by Uruguay's Ministry of Agriculture and Fisheries through its Directorate of Water Use and Management. About 90% of the country's total land area is under cultivation. As a result of outdated soil management and irrigation practices, heavy precipitation, and rapid evaporation, soil depletion and erosion are becoming serious problems. Pilot projects for demonstrating suitable irrigation and erosion control methods have been established in five different areas of the country. At these sites, varying in soil types, topography, and agricultural systems, information on local soil and cultivation is collected. Soils are wet to excessively wet, depending on depth, from April through September. By November the superficial soils have lost 75% of their moisture retention capacity. Lowest water content is seen in February. The water deficits are especially detrimental to growth of pasture grasses. Each year about 150 trained agronomists begin work with government and private agricultural concerns. (Cassar-FRC)
W83-03134

5. WATER QUALITY MANAGEMENT AND PROTECTION

THE USE OF MATHEMATICAL MODELS IN THE FORMULATION OF POLLUTION CONTROL POLICIES - AN OVERVIEW,
National Inst. for Water Research, Pretoria (South Africa).
A. Gerber.
Water Science and Technology, Vol 14, No 9-11, p 1045-1053, 1982. 3 Ref.

Descriptors: *Water pollution control, *Mathematical models, Model studies, Mathematical studies, Planning, Policy making.

Principles underlying the development of mathematical models are outlined in non-mathematical terms. Some of the advantages and limitations of computer models are highlighted, especially ways in which models may be misused. The skills required for effective modelling are sketched, as are major problem areas hampering the general application of models. The development and use of models involve several interrelated areas such as system conceptualization, model selection, data collection design, computer program use, history matching and prediction. When dealing with real systems a model is never exact, and complete data are never available; therefore use is an iterative process, to which one never achieves a final solution. Use of numerical models requires the model developer to determine and resolve data inadequacies, aids in conceptualizing system behavior, provides a means for solving extremely complex water-related problems, and provides through the computer code and data deck used a perfect record and means for transfering information as to how a problem was solved. (Baker-FRC)
W83-02864

5A. Identification Of Pollutants

ELIMINATION OF THE CHLORIDE INTERFERENCE IN THE DETERMINATION OF THE COD (BESEITIGUNG DER CHLORID-STORUNG BEI DER BESTIMMUNG DES CSB),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
R. Wagner, and W. Ruck.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 14, No 4, p 145-151, August, 1981. 9 Fig, 3 Tab, 29 Ref. English summary.

Descriptors: *Chemical oxygen demand, *Chlorides, Oxidation, Water analysis, Chemical analysis, Measurement techniques.

Although chloride ions do not influence the oxygen balance of natural waters, they are oxidized by dichromate in tests for chemical oxygen demand (COD). Three methods for overcoming this interference in COD testing are discussed: 1) quantitative oxidation of chloride ions to chlorine, under specified precautions, and correction of the results of the analysis for the calculated amount of oxidizing agent needed for this reaction; 2) use of mercuric sulfate as a sequestering agent for chloride ions; and 3) elimination of the chloride ions from the sample prior to the oxidation step through formation of hydrogen chloride by diffusion in a closed chamber to avoid losses of volatile oxidizable constituents. Results of kinetic investigations of the third option are presented. This method can be used to improve the determination of COD levels, enhancing the use of COD measurement in process control. (Author's abstract)
W83-02814

THE MEASUREMENT OF TOTAL PHOSPHORUS IN WASTE WATER (LE DOSAGE DU PHOSPHORE TOTAL DANS LES EAUX USEES),
Agence de Bassin Rhone-Mediterranee-Corse (France).
M. Bonnefille, R. Dugas, D. Peyre, and A. Tabonet.
Techniques et Sciences Municipales, No 5, p 301-306, May, 1981. 2 Fig, 6 Tab, 8 Ref. (No English Summary).

Descriptors: *Phosphorus, *Wastewater analysis, *Chemical analysis, Colorimetry, Mineralization, Sample preparation, Spectrophotometry, *Pollutant identification.

A method is proposed for the measurement of total phosphorus in domestic and industrial waste waters containing organic materials. The method involves the transformation of organic and inorganic phosphorus into orthophosphate ions for measurement using the French standard (AFNOR) procedure. Mineralization of the sample is accomplished by boiling in contact with air in the presence of sulfuric acid and ammonium persulfate for 1 hr after appearance of white fumes. Following addition of the detection reagent, the color produced is read at a wavelength of 880 nm, or less preferably 700 nm, within 10-20 min. The pH of the solution read in the spectrophotometer must be from 2 to 7, and the reagent blank reading must be subtracted. Potassium and ammonium ions interfere in the orthophosphate determination, while sodium and sulfate interfere only at higher levels. The analytical procedures also include precautions with respect to phosphorus impurities in some reagents. When a 50 ml sample is used, the limit of detection is about 0.2 mg of phosphorus per liter, with a reproducibility of about 5%. (Carroll-FRC)
W83-02816

DETERMINATION OF THE COLOUR OF WATER AND WASTE WATER (BESTIMMUNG DER FARBIGKEIT VON WASSERN),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
R. Wagner, and W. Ruck.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 14, No 4, p 152-154, August, 1981. 2 Fig, 2 Tab, 5 Ref. English Summary.

Descriptors: *Spectral analysis, *Color, Optical properties, Water properties, Physical properties, Wastewater analysis, Water analysis, Spectrophotometry, *Pollutant identification.

Methods C1 and C3 of the German Standard Methods for the Examination of Water, Waste Water, and Sludge define spectral absorption coefficients for special wavelengths. This paper suggests that the color of water and wastewater be characterized in a quantitative sense using the mean value of the spectral absorption coefficient in the range of visible light. The practical measuring

range--from clean surface water to wastewater from the textile industry--covers about three orders of magnitude and can be accommodated by commonly used photometric laboratory equipment. A standard for color is presented. The mean spectral absorption coefficient is an additive parameter, which may be supplemented by the recorded absorption spectrum for more qualitative considerations. The spectral absorption coefficient is easier to determine than the ADMI color value, proposed by the American Dye Manufacturers Institute for the same purpose, although there appears to be some relationship between these two parameters. (Author's abstract)
W83-02819

SOLUBLE REACTIVE PHOSPHORUS MEASUREMENTS IN LAKE MICHIGAN: CAUSES OF METHOD-SPECIFIC DIFFERENCES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Tarapchak, R. L. Chambers, and S. M. Bigelow.
Journal of Great Lakes Research, Vol 8, No 4, p 100-110, 1982. 1 Fig, 7 Tab, 34 Ref.

Descriptors: *Phosphorus, *Phosphates, *Pollutant identification, Soluble reactive phosphorus, *Lake Michigan, Ammonium molybdate, Grand River.

Three methods for determining soluble reactive phosphorus (SRP) were compared, using lake water samples from Lake Michigan and the Grand River. Harvey's method, the ascorbic acid method, and the Chamberlain-Shapiro extraction technique differed in acid strength, exposure time, and ammonium molybdate concentration. Longer exposure times (Harvey and ascorbic methods, 9 min) often resulted in higher SRP values. More phosphate-P was released from bound sources in lake water with 0.16 N HCl (extraction method) than with 0.4 N HCl (Harvey method). The discrepancies among methods were not proportional to variations in acid strength, exposure time, and molybdenum concentration but were related to differences in chemical composition of the SRP pool. Data generated by the different methods cannot be validly compared. In general, Harvey's method gave higher values than the ascorbic acid method. (Cassar-FRC)
W83-02821

A SIMPLIFIED SCHEME FOR THE ANALYSIS OF POLLUTANTS IN GROUNDWATER AND LEACHATES CONTAMINATED BY HAZARDOUS CHEMICALS,
Missouri Univ.-Columbia. Dept. of Chemistry.
S. E. Manahan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196667, Price codes: A04 in paper copy, A01 in microfiche. ater Resources Research Center Completion Report, Univ. of Missouri, Columbia, September, 1982. 56 p, 36 Fig, 4 Tab, 9 Ref. OWRT A-133-MO(1), 14-34-0001-2127.

Descriptors: *Hazardous wastes, Gas chromatography, Total organic carbon analysis, *Pollutant identification, *Water analysis, Groundwater, Leachates, Coal, Pollutant analysis, Coal gasification.

The overall objective of the research was the development of a solvent-based separation procedure for the fractionation of organic pollutants from a hazardous waste source in water into hydrophilic; insoluble (suspended); and organophilic acid, base, and neutral fractions. The fractions may be characterized at the simplest level by dissolved organic carbon analysis, leaving open the option for more sophisticated gas chromatographic and gas chromatographic/mass spectrometric analysis. The separation and analysis procedures have been proved on a variety of organic compounds obtained as by-products of underground coal gasification.
W83-02904

REAERATION RATE ESTIMATION USING THE LAG IN DISSOLVED OXYGEN CONCENTRATION,
Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
M. G. Waldon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-202341, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Louisiana State Univ., Baton Rouge, January 1983. 32 p, 4 Fig, 4 Tab, 10 Ref. 1 Append. OWRT A-054-LA(1), 14-34-0001-1120.

Descriptors: *Reaeration coefficient, Reaeration, *Dissolved oxygen, Productivity, Parameter estimation, *Peak lag method.

Estimation of the reaeration coefficient in a stream may be classified as a dynamic system parameter estimation problem. One classical method of parameter estimation widely used in other fields involves observation of the output of a system being 'forced' by a sinusoidal input signal. In some cases the system parameters may be estimated by simply observing the lag of the output to the input signal at one or more input frequencies. This classical method is here applied to the estimation of the reaeration coefficient. In this case, the forcing function or input is the diel production and consumptive of oxygen through photosynthesis and respiration. This function is assumed to be symmetrical and to peak at local true solar noon. A proposed relationship provides an estimate of the rearation coefficient based on the timing of the afternoon maximum of dissolved oxygen and the day length. This method, termed the 'Peak Lag Method', is derived and tested, and an extension is proposed which allows analysis of data from multiple stations along a stream. It is concluded that under some conditions the peak lag method provides an acceptable alternative to other estimation techniques.
W83-02914

THE MEASUREMENT OF COMPLEXATION CAPACITY AND CONDITIONAL STABILITY CONSTANTS FOR LIGANDS IN NATURAL WATERS,
Procter and Gamble Co., Cincinnati, OH.
T. A. Neubecker, and H. E. Allen.
Water Research, Vol 17, No 1, p 1-14, January, 1983. 5 Tab, 98 Ref.

Descriptors: *Metals, *Speciation, *Chelation, Fate of pollutants, Reviews, Organic matter, *Pollutant identification, Solubilization, Bioassay, Ion exchange, Voltammetry, Ion-selective electrodes, *Ligands.

The important factors controlling the speciation of metals in solution are reviewed, and the techniques used for measuring metal complexation in natural waters are discussed. The effects of inorganic species such as carbonate, chloride, or phosphate on metal speciation are readily characterized. The action of organic ligands, which occur in infinite variety, is less easily determined. Natural organic matter, such as humic and fulvic acids, accounts for most of the organic substances in surface waters. Some computer models for metal speciation exclude organic matter because of its assumed negligible role in complexation. Several methods available for determining metal speciation have limitations. These include ion-selective electrodes, biological techniques, solubility measurements, ion exchange, and voltammetry. Despite limitations, a combination of ion exchange and voltammetry is popular. Some miscellaneous methods include metal ion catalysis of oxidation-reduction reactions, Chelex 100 resin, gas filtration, dialysis, and fluorescence quenching. The complexation capacity is defined by the type of measurement and the reference metal. Therefore, there is a need for extensive intercomparison of methods. (Cassar-FRC)
W83-02957

HYDROLOGIC CHARACTERISTICS OF SURFACE-MINED LAND RECLAIMED BY SLUDGE IRRIGATION, FULTON COUNTY, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
G. L. Patterson, R. F. Fuentes, and L. G. Toler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124982, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-16, August 1982. 30 p, 16 Fig, 7 Tab, 20 Ref.

Descriptors: *Land reclamation, *Strip mines, *Water quality, *Hydrologic data, Networks, Monitoring, Sludge, Surface water, Strip mine lakes, Sediment discharge, Groundwater, Water table, *Illinois, Fulton County.

Analyses of water samples collected at four stream-monitoring stations, in an area surface mined for coal and being reclaimed by sludge irrigation, show the principal metals are sodium, calcium, and magnesium and principal non-metals are chloride, sulfate, and bicarbonate. Comparing yearly mean chemical concentrations shows no changing trends since reclamation began, nor are there differences between stations upstream and downstream from the site. Yearly suspended-sediment loads and discharge relations upstream and downstream from the site also show no differences. Discharge hydrographs of two streams draining the site show a delayed response to precipitation due to the storage capacity of several upstream strip-mine lakes. The water-table surface generally follows the irregular topography. Monthly water-level fluctuations were dependent on the surface material (mined or unmined) and proximity to surface discharge. The largest fluctuations were in unmined land away from discharge while the smallest were in mined land near discharge. The water table is closer to the surface in unmined land. Analyses of water samples from 70 wells within or adjacent to the reclamation site showed no differences in water quality which could be attributed to sludge or supernatant application. Samples from wells in mined land, however, had higher concentrations of dissolved sulfate, calcium, magnesium, chloride, iron, zinc, and manganese than samples from wells in unmined land. (USGS)
W83-02975

HYDROLOGIC DATA OF THE LAKE COCHITUATE DRAINAGE BASIN, FRAMINGHAM-NATICK, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W83-02989

ATYPICAL MYCOBACTERIA ISOLATED AT CATANIA (MICROBATTERI ATIPICI ISOLATI A CATANIA),
Catania Univ. (Italy). Cattedra di Dermatologia Pediatrica.
M. Marranzano, B. Guarneri, M. Biondi, S. Sciacca, and G. Leonardi.
Igiene Moderna, Vol 77, No 2, p 317-324, 1982. 5 Tab, 12 Ref. English summary.

Descriptors: *Mycobacteria, Swimming pools, Aquariums, Bacteria, *Aquatic bacteria, Pathogenic bacteria, Epidemiology, Public health, Human diseases, *Italy, Catania.

A study was undertaken to determine the mycobacteria found in swimming pools and aquariums in Catania, Italy and to determine whether persons having contact with these sources experienced skin infections as a result. The following mycobacteria were isolated in waters taken from swimming pools in use in Catania: M. gordonae, M. triviale, M. smegmatis, and M. fortuitum. Aquariums in private homes and pet shops in Catania were found to have M. kansasii, M. gordonae, M. terrae, M. smegmatis, M. fortuitum, and M. chelonei. No case of skin infection was noted in any person using the swimming pools, nor were there any recorded cases of skin infection from these sources in the lists of outpatients at the Dermatological Clinic of the University of Catania (a total of 10,613 patients over a 4-year period). (Author's abstract)
W83-03009

A SAPONIFICATION PROCEDURE FOR THE DETERMINATION OF SOME CHLORINATED HYDROCARBONS IN FISH,

Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
M. S. Simmons, J. A. Sweetman, T. J. Miller, and D. J. Jude.
Journal of Great Lakes Research, Vol 8, No 3, p 587-589, 1982. 3 Tab, 6 Ref.

Descriptors: *Pesticide residues, *Fish, *Chlorinated hydrocarbons, *Pollutant identification, *Saponification, Polychlorinated biphenyls, Lake Huron, Whitefish, Aldrin, Dieldrin, DDT, Endrin, Organic compounds, Aromatic compounds.

A rapid method for determination of chlorinated hydrocarbon residues in fish involves saponification with alcoholic potassium hydroxide and chromatography on activated silica gel columns with petroleum ether and diethyl ether eluates, followed by gas chromatography equipped with electron-capture detection. Recoveries of aldrin, DDT and metabolites, polychlorinated biphenyls (PCB), dieldrin, and endrin were 82-94%. Pesticide residues in Lake Huron round whitefish were: PCB, 0.130-1.89 ppm: DDT and metabolites, 0.018-0.76 ppm; aldrin, 0.002-0.040 ppm; and dieldrin, none detected to 0.016 ppm. The method is not applicable to lindane, chlordane, heptachlor, and toxaphene, because these compounds dehydrohalogenate during the saponification step. (Cassar-FRC)
W83-03077

SOLUBLE REACTIVE PHOSPHORUS MEASUREMENTS IN LAKE MICHIGAN: FILTRATION ARTIFACTS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Tarapchak, S. M. Bigelow, and C. Rubitschun.
Journal of Great Lakes Research, Vol 8, No 3, p 550-557, 1982. 4 Tab, 25 Ref.

Descriptors: *Lakes, *Water analysis, *Phosphorus, *Filtration, Measuring instruments, *Lake Michigan, Great Lakes, Filters, *Pollutant identification.

A preliminary study was undertaken to evaluate the importance of filtration artifacts in soluble reactive phosphorus (SRP) estimation using water from southern Lake Michigan. This report demonstrates that SRP estimates can be seriously biased by variations in filtration procedures, that release of molybdate reactive P04-P from abiotic particulate material can occur, and that filtration artifacts are partially responsible for method-specific differences in SRP estimation. Variations in vacuum pressure and filter pore size can bias estimates by approximately 100%, and variations in sample volume alone can produce nearly a twofold difference in SRP values. The best set of filtration conditions for SRP estimation cannot be specified from the analyses reported here. Leakage of molybdate-reactive P04-P from fragile organisms will vary seasonally depending on variations in their abundance and surplus P content. Similarly, reductions in SRP caused by filter clogging will vary with the amount of debris in the water and on the density and size of P-containing particles. For routine SRP estimation it is recommended that constant vacuum pressure and sample volumes be used along with the same filter type and size. (Baker-FRC)
W83-03084

ARTIFACTS AND LOSSES IN THE SAMPLING OF CHLORINATED WATERS BY XAD ADSORPTION,
American Univ., Washington, DC. Dept. of Chemistry.
A. M. Cheh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208843, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center, University of the District of Columbia, Report No 45, April 1983. 58 p, 14 Fig, 4 Tab, 9 Ref. OWRT A-017-DC(1), 14-34-0001-2109.

Descriptors: *Water sampling artifacts, *Chlorination, *XAD resins, *Mutagens, *Ames assay, High performance liquid chromatography, Electrophiles, *Pollutant identification.

Chlorination of natural waters generates mutagens that most likely are electrophiles. These electrophiles are often recovered for testing and analysis by adsorption to XAD resins. It was found that the production of artifacts stemming from the action of free chlorine on XAD-4 resin could be suppressed at least ten fold by converting the free chlorine to chloramine. Kinetic studies indicate that free chlorine is consumed at least ten times as rapidly by XAD-4 as in chloramine. Sampling losses during XAD recovery of electrophiles and mutagens were also examined. Mutagenic activity bound to resins generally decreased over a period of several days, but some increases were seen. Electrophiles labeled by 4-nitrothiophenol generally decreased concurrently, but sometimes new species were seen. Organics concentrates in ethanol did not appear to lose mutagenic activity as rapidly as concentrates in DMSO. Simultaneous electrophile assays, however, indicated up to 50% loss of some electrophiles present in ethanol concentrates.
W83-03104

IDENTIFICATION OF TOTAL AND BIOLOGICALLY SENSITIVE FORMS OF TOXIC METAL INPUTS TO AN URBAN AFFECTED RIVER,
Washington Univ., Seattle. Fisheries Research Inst.
E. D. Thielk, and S. P. Felton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208850, Price codes, A04 in paper copy, A01 in microfiche. Publication No FRI-UW-8303, February 1983. 52 p, 15 Fig, 7 Tab, 39 Ref, 1 Append. OWRT A-116-WASH(1), 14-34-0001-1140.

Descriptors: Water pollution, *Heavy metals, *Copper speciation, Polarography, Pollution control, Complexing capacity, Complexometric titration, *Copper, Ligands, Reducible copper, Labile copper, *Pollutant identification, *Washington, Green River, *Voltammetry.

A need for inexpensive approaches for the determination of biologically available forms of copper has been established. Differential pulse anodic stripping voltammetry (DPASV) has been proposed as an inexpensive simple approach for these types of determinations. This study investigated copper speciation at six stations on the Green River, Washington, using DPASV. Measurements included total and DPASV reducible copper concentrations, DPASV complexing capacity of unidentified, naturally occurring ligands, and DPASV complexing capacity of specific copper ligands (PO sub 4, P sub 2 O sub 7, CO sub 3, glycine, citrate, oxalate, and EDTA). No endpoints to complexation reactions were observed for any sample. DPASV measurements in the presence of specific copper ligands demonstrated considerable dissociation of all complexes during deposition phase of the measurement, including copper-EDTA complexes. This phenomenon most likely resulted in determination of excessively high concentrations of reducible copper in river water, and may have accounted for low amounts of apparent complexation. The technical aspects of these measurements and sources of interference were discussed in terms of the data collected. It was concluded that the use of DPASV for making determinations of biologically available copper is limited.
W83-03105

MODIFIED STRIPPING TECHNIQUE FOR THE ANALYSIS OF TRACE ORGANICS IN WATER,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
H. Boren, A. Grimvall, and R. Savenhed.
Journal of Chromatography, Vol 252, p 139-146, 1982. 9 Fig, 9 Ref.

Descriptors: *Organic compounds, *Trace levels, *Pulp and paper industry, *Pollutant identification, Gas chromatography, Motala River, *Sweden, Wastewater analysis, Water analysis, Fate of pollutants.

The closed loop stripping analysis for detecting trace organics in water was modified to increase the range of stripping temperature and flow rate of purging gas and to reduce problems of contamination. This modification, designated the straight and open system, involved shortening of tubing, substitution of stainless steel tubing with PTFE tubing, replacement of a glass frit with a glass capillary tube, change to an open loop system, and removal of trace organics in the nitrogen stripping gas by activated carbon adsorption. The modifications produced very few blank peaks in the subsequent gas chromatograms. The method was used to study trace organics in raw water from the Motala River, Sweden, a drinking water source, and in wastewater from municipal and pulp mill sources. Most of the organic compounds present (illustrated by chromatograms of the sesquiterpene fraction) in the water works supply were also present in the pulp mill wastewater. (Cassar-FRC)
W83-03131

MAXIMUM CONTAMINANT LEVELS FOR TOXIC SUBSTANCES IN WATER: A STATISTICAL APPROACH,
Wisconsin Univ.-Milwaukee. Dept. of Urban Planning.
G. W. Page, and M. Greenberg.
Water Resources Bulletin, Vol 18, No 6, p 955-963, December, 1982. 3 Fig, 6 Tab, 34 Ref.

Descriptors: *Water quality standards, *Statistical analysis, *Priority pollutants, Maximum contaminant levels, Standards, Carcinogens, Organic compounds, Pesticides, Cadmium, DDT, Above trace method, Outliers, Trace levels, *Pollutant identification.

The above Trace Method proved more satisfactory for establishing maximum contaminant levels (MCL) or nondegradation standards for toxic substances in water than two other methods, the half minimum method and the log-normal method. It is based on statistical outlier procedures which distinguish ubiquitous background levels of toxic substances from concentrations significantly greater than background. The Above Trace Method does not make assumptions about the true concentration of samples which have trace or nondetectable levels. However, it failed to detect any outliers (therefore failed to estimate MCL) for 17 of 42 toxic organic chemicals. Pesticide results were also inconsistent. Using data obtained from analyses of water samples, the method can calculate a conservative interim MCL suitable for protecting the public until data based on human health studies are available. Since the period between carcinogen exposure and resulting cancer can be 20-30 yr, it is likely that the human health statistics for the priority pollutants may not be available within 30 years. (Cassar-FRC)
W83-03145

5B. Sources Of Pollution

CONTENTS OF METALS AND SUSPENDED SOLIDS IN THE RHINE (METALLGEHALT UND SCHWEBSTOFFGEHALT IM RHEIN),
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.).
K. -G. Malle, and G. Muller.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 15, No 1, p 11-15, 1982. 3 Fig, 4 Tab, 17 Ref. English summary.

Descriptors: *Suspended solids, *Heavy metals, Rivers, Bottom sediments, Suspended load, Copper, Chromium, Lead, Zinc, Mercury, Cadmium, *Rhine River, Fate of pollutants, *Federal Republic of Germany.

Metal and suspended solids concentrations in the Rhine at the German-Dutch border have been studied since 1973. The suspended solids content of the river has not changed significantly during this period. However, the concentrations of chromium, copper, zinc, cadmium, mercury, and lead are all declining. The decreases in the chromium and mercury concentrations are observed mostly as decreases in the concentrations of these metals in the

suspended solids, while zinc and cadmium concentrations have been reduced in the liquid phase. The metal concentrations in the river sediments largely coincide with the metal concentrations in the suspended solids. Although the Rhine carries an increased load of suspended solids when flow increases significantly, the transport of metals is not comparably increased during these events. Copper, zinc, and lead loads change distinctly with seasonal water flow changes, while chromium, cadmium, and mercury loads are relatively unaffected by seasonal changes. (Author's abstract)
W83-02813

HISTORY OF ACCIDENTAL POLLUTIONS WHICH HAVE OCCURRED IN THE WORLD (HISTORIQUE DES POLLUTIONS ACCIDENTELLES SURVENUES DANS LE MONDE),
A. Amezal, J. F. Bost, A. Guiraud, and Y. Merillon.
Techniques et Sciences Municipales, No 5, p 293-300, May, 1981. 5 Fig. (No English Summary).

Descriptors: *Water pollution control, *Water pollution prevention, *Water pollution sources, Pollutants, Accidents, Water pollution effects, *History.

Water distributors, the Regional Directorate for Equipment, and the Seine-Normandie Basin Authority have cooperated in conducting a study of cases of accidental water pollution occurring both in France and in other countries. Two approaches were taken in this study. The first was to identify and analyze the risks of accidental water pollution historically in both France and some industrialized countries. The second was to identify the sources of accidental pollution risks and means of limiting those risks. The effects of time of day, week, or year on the number of pollution accidents; the sources of pollution; the principal causes of pollution accidents, the principal pollutants involved in accidents; and the consequences of pollution accidents are discussed. Industries were found to be major sources of pollution accident risks. Hydrocarbons were the pollutants most often implicated, although pollution from chemical problems posed a greater threat to public health. While many of the recorded water pollution accidents had serious consequences, many could have been avoided and their consequences minimized through the implementation of simple and inexpensive measures. Those responsible for water quality should make prevention of water pollution accidents a major concern and should stress the application of measures needed to minimize pollution events. (Carroll-FRC)
W83-02817

METAL ION COMPLEXATION BY AQUATIC HUMUS. III. MODEL DEVELOPMENT AND RELATION TO SURFACE WATER. (KOMPLEXIERUNG VON METALLIONEN DURCH GEWASSERHUMINSTOFFE. III. MODELLENTWICKLUNG UND GEWASSERBEZUG),
Technische Univ., Munich (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
F. H. Frimmel.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 14, No 1, p 7-10, February, 1981. 5 Tab, 27 Ref. English Summary.

Descriptors: *Decomposing organic matter, *Heavy metals, *Dissolved solids, Metals, Iron, Mercury, Copper, Molecular structure, Chemical reactions, Chemical properties, Flocculation, Humic substances, Fate of pollutants.

Although a realistic model of humic substances cannot be represented by a molecular structure, functional groups can be quantitatively determined. The properties of humic substances isolated from various waters were applied to a hypothetical compound having a molecular weight of 3,000. This compound was found to have between 11 and 15 sites suitable for protonation under conditions present in surface water. Between 4 and 9 equivalents of copper(II) could be complexed. Although strong coordination of iron(II,III) and mercury(II) was also possible, the number of sites suitable for such complexation was much smaller. Flocculation experiments with aerated brown water showed a significant decrease in dissolved metals and dissolved organic substances. These results, together with data on the the metal concentrations in unpolluted brown water and on the background values for fresh water, indicate that humic substances are of great importance for the dissolved metals content of water resources. Between 1 and 5 micromoles of heavy metals can be bound to humic materials at 1 milligram DOC. (Author's abstract)
W83-02818

MASS BALANCE MODELING OF HEAVY METALS IN SAGINAW BAY, LAKE HURON,
Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
D. M. Dolan, and V. J. Bierman, Jr.
Journal of Great Lakes Research, Vol 8, No 4, p 676-694, 1982. 14 Fig, 5 Tab, 28 Ref.

Descriptors: Metals, *Sediments, *Lake sediments, *Fate of pollutants, *Heavy metals, Zinc, Copper, Cadmium, Lead, Saginaw Bay, *Lake Huron, Model studies, Suspended sediments, Adsorption, Sedimentation, Wind-driven currents, Particulate matter, Path of pollutants.

A spatially segmented dynamic mass balance model was developed to describe the concentration of metals (cadmium, copper, lead, and zinc) and suspended solids in the water column and sediment of Saginaw Bay, Lake Huron. About 20,000 data points were obtained at 30 stations during 37 cruises in 1976-78. Suspended sediments were important in controlling metals concentrations. The degree of control was a function of the partition coefficient between adsorbed and dissolved phases of the metal, the suspended solids dynamics of the system, and the magnitude of the sediment reservoir. Metals levels in the water column can decrease due to solids adsorption and sedimentation and increase due to resuspension, usually wind-driven. Total metals concentrations in the water column were most sensitive to settling rates of suspended sediments; dissolved metals concentrations, to the value of the partition coefficient. Large percentages of cadmium (77%), lead (28-38%), and zinc (15-79% were lost to the sediments each year. Copper showed little or no loss. (Cassar-FRC)
W83-02820

VERTICAL DISTRIBUTION OF PROFUNDAL BENTHOS IN LAKE SUPERIOR SEDIMENTS,
Normandale Community Coll., Bloomington, MN.
For primary bibliographic entry see Field 2H.
W83-02822

LAKE ONTARIO SEDIMENT-MIREX RELATIONSHIPS,
State Univ. of New York Coll. at Oswego.
R. J. Scrudato, and A. DelPrete.
Journal of Great Lakes Research, Vol 8, No 4, p 695-699, 1982. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Mirex, *Pesticides, *Sediments, *Insecticides, *Lake Ontario, Oswego River, Oswego Anomaly, Bottom sediments, Lake sediments, Sedimentation rates, Organochlorine pesticides.

Mirex levels were determined in bottom sediment samples collected in the Oswego River and harbor and offshore in Lake Ontario during May 1979. Highest concentrations (1834 ng per g) were found immediately downstream from the Armstrong Cork Company discharge, 14 km upstream from the lake. Mirex concentrations were none detected to 48 ng per g in Oswego Harbor and none detected to 32.5 ng per g at the offshore dredge material disposal site 4 km offshore. In the most contaminated of 4 sites in the Oswego Anomaly offshore (depths 88-223 m) mirex levels were 22-73 ng per g in the upper 5.5 cm of sediments and below the detection limit in sediments deeper than 6.5 cm. Depth of mirex contamination at the 4 anomaly sites varied from 1.5 to 10.5 cm. There was a high correlation between organic carbon concentrations (0.6-3.7%) and mirex concentrations. Mirex-contaminated sediments are accumulating in the deep water lake sediments (> 100 m) at the rate of 2.2-7.0 mm per year. At shallower water depths sediments accumulate more slowly or are subject to redistribution. Although the river continues to supply mirex to the lake sediments, deposition is apparently decreasing, as reflected in the lower mirex levels found in the most recent sediments. However, it is estimated that covering of the contaminated sediments with clean sediment may require 200-600 years. (Cassar-FRC)
W83-02823

MORTALITY PATTERNS OF INDICATOR ORGANISMS DURING AEROBIC DIGESTION,
Black and Veatch, Denver, CO.
For primary bibliographic entry see Field 5E.
W83-02834

MICROBIOLOGICAL AEROSOLS FROM A FIELD-SOURCE WASTEWATER IRRIGATION SYSTEM,
Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
H. T. Bausum, S. A. Schaub, R. E. Bates, H. L. McKim, and P. W. Schumacher.
Journal of the Water Pollution Control Federation, Vol 55, No 1, p 65-75, January, 1983, 4 Fig, 9 Tab, 20 Ref.

Descriptors: *Aerosols, *Wastewater irrigation, *Microorganisms, Wastewater disposal, Spray irrigation, Wastewater lagoons, Deer Creek Lake State Park, *Ohio, Lagoons, Irrigation, Bacteria, Fate of pollutants, Pathogens, Land application, Viruses, Public health, Air pollution.

The fate of bacterial aerosols generated by a sprinkler irrigation system (96 sprinklers, 2.5 ha) using ponded chlorinated domestic wastewater was determined by Andersen stacked-sieve viable-type air samplers. The wastewater characteristics were: median standard plate count, 29,000 CFU per ml; total coliforms, 170 CFU per ml; fecal coliforms, 0.55 CFU per ml; coliphages, < 2-10 PFU per ml in the second lagoon. Bacterial aerosol levels averaged 485 CFU per cu m (ranged 46-1582 CFU per cu m) above simultaneous background levels at 21-30 m downwind and were an order of magnitude less at 9.1 m above ground level and 200 m downwind. Sodium fluorescein tracer studies indicated that 0.56% of nonvolatile materials in the wastewater escaped the spray zone as an aerosol. Estimated mean bacterial dieoff was 52% at 21-30 m downwind 77% at 200 m downwind. 66-78% of particles at 21-30 m downwind were 1-5 microns in diameter, the range for efficient pulmonary deposition. Mean aerodynamic particle size of bacteria-carrying particles was 2.5-2.8 microns downwind and 4.4 microns upwind. (Cassar-FRC)
W83-02835

SOURCES OF PETROLEUM HYDROCARBON INPUTS TO THE MARINE ENVIRONMENT,
BP International Ltd., London (England).
F. G. Payne, and M. T. Westaway.
Water Science and Technology, Vol 14, No 9-11, p 1159-1170, 1982. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Water pollution sources, *Coastal waters, *Oil industry, Organic compounds, Industrial wastes, Runoff, Urban runoff, Rivers, Surface runoff, Air pollution.

The possibility of petroleum hydrocarbons entering the marine environment has increased considerably considering the following potential sources: natural seeps, offshore oil production, marine transportation and associated facilities, coastal refineries, municipal and other industrial effluents, atmosphere, and urban and river run-off. The major sources of oil contaminated effluent from refinery operations are associated with cooling water and discharges from process plant. It has been estimated that on a global basis 60,000 tonnes per annum of petroleum hydrocarbons entered the marine environment from coastal refineries. There are considerable problems in assessing the input of petroleum hydrocarbons to the marine environment from the atmosphere with 600,000 tonnes per annum representing the current estimate. A large proportion of these enter the air from vehicle

emissions. Urban and river run-off has been estimated to contribute 1.8 million tonnes per annum of the petroleum hydrocarbons entering the marine environment. About 450,000 million tonnes per annum of petroleum hydrocarbons enter the marine environment from coastal municipal and non-refinery industrial effluents. Discharges are more serious the closer to shore they occur as generally this is also the area of greater ecological sensitivity. (Baker-FRC)
W83-02863

APPLICATION TO ESTUARINE AND COASTAL WATERS,
Water Research Centre, Stevenage (England).
A. L. H. Gameson.
Water Science and Technology, Vol 14, No 9-11, p 1055-1072, 1982. 3 Fig, 66 Ref.

Descriptors: *Water pollution control, *Model studies, Planning, Mathematical models, Hydrology, Policy making, Coastal waters.

Principles which underlie the mathematical modeling of parameters of pollution in estuarine and coastal waters are outlined in non-mathematical terms. Difficulties encountered in modeling include assessing the inputs of relevant substances, evaluating coefficients of transformation processes, and ensuring that models can reasonably be used for predictive purposes. The four basic processes which a model must represent include input, transport, dispersion and transformation. The model must also take into account the hydrology of the system, and it must be validated. Two examples are given, one of which relates to dissolved oxygen in an estuary, and the other to enteric bacteria in the sea. The application of models to the formation of pollution control policies is reviewed. At present the modeling of the effect of coastal discharges does not appear to have been refined to the same extent as for estuarine discharges. The determination and representation of water movements and dispersion are more difficult, and the kinetics of bacterial mortality are not well understood. (Baker-FRC)
W83-02865

MINERALIZATION PROBLEMS IN THE PWV COMPLEX - THE IDENTIFICATION OF VIABLE SOLUTIONS BY MEANS OF A SUITE OF MATHEMATICAL MODELS,
Steward, Sviridov and Oliver, Johannesburg (South Africa).
For primary bibliographic entry see Field 5G.
W83-02881

THE ENUMERATION OF STREPTOCOCCI AND MYCOBACTERIA PRESENT IN LANDFILL LEACHATE,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
J. A. Donnelly, P. V. Scarpino, and D. Brunner.
Water Science and Technology, Vol 14, No 9-11, p 1555-1556, 1982.

Descriptors: *Leachate, *Water pollution sources, *Streptococcus, Bacteria, Landfills, Waste dumps, Garbage dumps, *Mycobacteria, Fate of pollutants.

At attempt was made to measure the presence of pathogenic indicators and pathogenic microorganisms in landfill leachate to determine the significance of this leachate when it drains into the environment. The sample source was a large commercial landfill in a 600 acre site. It received 2500 tons of municipal and commercial solid waste daily. The leachate was taken at five sites 150 feet below the crest of the landfill and 50 feet above the base. Leachates from lysimeters over one year old yielded only Group D streptococci, while fresh leachate from an active commercial landfill contained streptococci from D-enterococcus, D-non-enterococcus, and the viridans groups. All of these originated in human or animal waste. The significance of these findings is the fact that relatively high concentrations of fecal streptococci, fecal pathogens and mycobacteria were present in the leachate leaving the landfill, leading potentially to a contaminated environment. (Baker-FRC)
W83-02885

THE SURVIVAL OF BACTERIAL INDICATORS IN LYSIMETERS AND LANDFILLS,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5E.
W83-02886

PARASITES IN SOUTHERN SLUDGES AND DISINFECTION BY STANDARD SLUDGE TREATMENT,
Tulane Univ., New Orleans, LA. School of Public Health and Tropical Medicine.
R. S. Reimers, M. D. Little, A. J. Englande, D. B. Leftwich, and D. D. Bowman.
Water Science and Technology, Vol 14, No 9-11, p 1568, 1982.

Descriptors: *Sludge, *Parasites, *Land disposal, Waste disposal, Wastewater treatment, Municipal wastes.

This study was designed to assess the occurrence and distribution of resistant parasite stages in municipal wastewater sludges in the southern United States, to determine the fate of helminth eggs through a wastewater treatment plant, and to evaluate standard sewage sludge treatment processes for parasite inactivation effectiveness. One important finding was the poor suitability of Ascaris eggs taken from the uteri of gravid female worms as indicators of the characteristics of Ascaris eggs discharged in the feces of the host. The eggs removed from the gravid females are not as resistant to adverse factors as eggs that have undergone a hardening process in the intestines of the host and have been recovered from the feces. For the study sludge samples were collected during each of the four seasons from 27 municipal wastewater plants located in Alabama, Florida, Mississippi, Louisiana, and Texas and examined for presence and densities of resistant stages of human and animal parasites using parasitologic techniques. Viable eggs of Ascaris eggs of Ascaris and Toxocara were recovered at least once from every plant, and viable eggs of Ascaris and Toxocara were recovered at least once from every plant, and viable eggs of Trichuris vulpis and Trichuris trichiura from all but one plant. (Baker-FRC)
W83-02887

A CHEMICAL INVESTIGATION OF A MARINE SEWAGE OUTFALL,
National Research Inst. for Oceanology, Stellenbosch (South Africa).
P. D. Bartlett, and G. A. Eagle.
Water Science and Technology, Vol 14, No 9-11, p 1588-1589, 1982.

Descriptors: *Wastewater outfall, *Metals, *Water pollution effects, Table Bay, *South Africa, Zinc, Iron, Bays, Marine environment, Chemical analysis.

The behavior of sewage from a single outfall on entering the sea was studied. The contribution of this effluent to the overall chemical budget of Table Bay, situated at the northern end of the Cape Peninsula near the southwestern tip of Africa, is being investigated. Water and sediment samples were collected from 45 stations. The contour maps showed clear plumes for many of the chemical parameters extending from the outfall. The shape of the plume depends on the wind regime at the time of sampling. Degradation of the sewage leads to lower oxygen levels in the water. The highest concentrations of all the trace metals studied in the sediments were in the Granger Bay harbor entrance area. It is not yet clear if these metals originate from the sewage. All nutrients showed a net removal within the bay, which is to be expected due to the high productivity of the area. The nutrient contribution from sewage is likely to be small compared to that from the upwelling process. Most of the amounts of metals added by the effluent were insignificant compared with the masses already present. In the case of iron and zinc the amounts added daily were up to 4% of the total mass already present. Under calm conditions Zn levels could rise and give cause for concern. (Baker-FRC)
W83-02888

NUTRIENT-SALINITY RELATIONSHIPS IN FOUR ESTUARIES OF THE CAPE PROVINCE, SOUTH AFRICA,
National Research Inst. for Oceanology, Stellenbosch (South Africa).
G. A. Eagle, and P. D. Bartlett.
Water Science and Technology, Vol 14, No 9-11, p 1590-1592, 1982. 4 Ref.

Descriptors: Water pollution effects, *Estuarine environments, Dissolved oxygen, Silicates, Phosphates, Nitrates, Chemical analysis, Phytoplankton, Water analysis, Coastal waters, *Salinity, *Nutrients, *South Africa, Cape Province, *Path of pollutants.

Estuarine environments were studied to investigate possible pathways for the transport of pollutants from land to sea. The estuaries studied were the Orange, Olifants, Berg and Breede. All are relatively unpolluted except for agricultural runoff. The mouth of the Berg River has been modified by the construction of breakwaters, but other estuary mouths are still in their natural states. The degree of penetration of saltwater into the estuaries was far more dependent on river flow than on tides. The distribution and levels of dissolved nitrate in the water indicate that two nitrate sources occur - land runoff and upwelled marine water. Phosphate concentrations in estuaries normally remain more or less constant due to some form of buffering mechanism. The expected inverse linear relationship between silicate concentration and salinity was noted. However, in the Olifants River there appeared to be a rapid decrease in silicate in two stages, between salinities of 3 and 5% and 30 and 35%. The dissolved oxygen concentrations in all the rivers were close to the theoretical saturation lines. The sharp decrease noted near the freshwater-seawater interface in the Tamar estuary was not noted in any of the estuaries here. In the Olifants River there was nevertheless a drop in oxygen levels around the mid-estuary region, probably due to a high BOD in the area arising from the mortality of halophobic phytoplankton. (Baker-FRC)
W83-02889

METAL INPUT AND MOBILIZATION IN TWO ACID-STRESSED LAKE WATERSHEDS IN MAINE,
Maine Univ. at Orono. Dept. of Geological Sciences.
J. S. Kahl, and S. A. Norton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208256, Price codes: A05 in paper copy, A01 in microfiche. Land and Water Resources Center Completion Report, Univ. of Maine at Orono, January 1983. 70 p, 26 Fig, 9 Tab, 34 Ref, 4 Append. OWRT A-053-ME(1).

Descriptors: *Acid rain, Forest soils, *Heavymetals, Sediment-water interfaces, *Maine, Lake watersheds, Second Pond, Little Long Pond, Sediments, Lead, Zinc, Calcium, Hydrogen ion concentration.

Two ponds in Hancock County (ME), Little Long and Second, were chosen for a comparative study of metal inputs and mobilization. Seasonal pH ranges of surface waters are 4.5-5.6 at Little Long, and 6.0-6.8 at Second Pond, although precipitation loading of acids and metals is very similar. Watershed lithologies are similar; soils at Little Long are lower in exchangeable and organically-bound Ca and relatively rich in mobile Al, compared to Second Pond soils. Dated sediment chemical profiles indicate that accelerated atmospheric inputs of trace metals began in the mid-1800's. Modern sediments and soils have accumulated excess Pb and Zn, although the Zn/Pb ratio is lower in sediments and in soils than it is in precipitation, due to greater Zn mobility. Sediment depletion in Ca, Mn, and Zn in Little Long may be due to in-situ leaching of

sediments by increasingly acidic lake waters. Experiments with limnocosms show that up to 50% of the Ca and Mn, and 25% of the Zn, in recent sediments may be leached at a pH near 4.0 in less than a year. Nearly 10% of the Ca and Zn was mobilized at pH 5.0.
W83-02891

STATEWIDE EVALUATION OF TRACE ELEMENT ACCUMULATION FROM LONG TERM DISPOSAL OF WASTE WATER,
California Univ., Irvine.
For primary bibliographic entry see Field 3C.
W83-02892

HYDROCARBON SPILLS, THEIR RETENTION IN THE SUBSURFACE AND PROPAGATION INTO SHALLOW AQUIFERS,
Minnesota Univ., St. Paul. Dept. of Geology and Geophysics.
H. O. Pfannkuch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196477. Water Resources Research Center Completion Report, University of Minnesota, St. Paul, April 1983. 51 p, 18 Fig, 5 Tab, 4 Ref. OWRT A-041-MINN(1).

Descriptors: *Oil spill pollution, *Groundwater contamination, *Unsaturated zone propagation, Saturated zone propagation, Mass transfer, *Dissolved hydrocarbons, Laboratory retention of hydrocarbons, *Path of pollutants, Water pollution sources, Shallow aquifers.

The two most important phases in the propagation of a hydrocarbon spill into the subsurface occur in the vadose or unsaturated zone, between the land surface and the water table, and in the groundwater flow zone at its contact with the free oil phase. The last determines the dissolution and spreading of contaminants through the most mobile flow zone. The first determines the spill geometry, the amount of free phase oil that reaches the groundwater body and the total retention of spilled oil. Oil retention studies carried out for this project show whether the volume of soil within a spill site is sufficient to retain the soil without it escaping into the groundwater, and also gives a rough approximation of how long it takes for the oil phase to reach pendular saturation. Grain size and sorting distribution are integral factors governing retention, and are useful parameters in evaluating the potential damage of an oil spill and the immediate danger of groundwater contamination. Centrifuge air-oil water displacement provides a quick and first order approximate means to measure site-specific oil and water retention within the unsaturated zone of a porous media. Results show a semi-log relationship between total primary retention annd grain size (in phi units) of laboratory samples with oil-water-air systems run under 38 g in the centrifuge. A correction factor adjusts retentions to gravity drainage column pack saturations after gravity drainage used as a standard of comparison. Field samples from an oil spill site assume the same relationship when plotted against effective particle size versus total primary retention.
W83-02895

SALINITY AND BORON CONTROL UNDER HIGH-FREQUENCY LOW-VOLUME IRRIGATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
R. J. Miller, D. E. Rolston, J. W. Biggar, and R. S. Raushkolb.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196709, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center, Univ. of California, Davis, March 1983. 30 p, 20 Fig, (Califronia Water Resources Center Project UCAL-WRC-W-545). OWRT B-197-CAL(1).

Descriptors: *Trickle irrigation, *Salts, *Boron, *Soil profiles, *Evapotranspiration, Saline soils, Irrigation, Soil water, Grape vines, *California.

A 3-year study of the accumulation of soluble salts and boron in a soil profile following trickle irrigation with well water is completed. Irrigation treatments consisted of three levels of water applications based on estimated evapotranspiration (ET) requirements of grape vines. Estimates of ET were obtained from soil data using a neutron (CPN) meter. Soil water potentials obtained by tensiometers at different soil depths provided information about soil water movement. Analyses of soil samples taken in 1981 showed slow but continued salt and boron accumulation during irrigation periods. Plant samples showed boron accumulation in the grape leaves during the irrigation season. Leaves from the lowest irrigation level (2/3 ET) showed higher boron contents than did 3/3 ET level which was higher than the 4/3 ET irrigation treatment. Chloride accumulation in the plant leaves increased similar to that of boron, howeve, sodium did not, although it did accumulate in leaf petioles during the irrigation season in all treatments. In general, plant tissues reflected the sodium, chloride, and boron concentrations found in the soil. Grape yields in 1982 responded to the higher irrigation levels and yields were considerably larger than the local area average. (Snyder-California)
W83-02908

MICROBIAL DEGRADATION OF NATURAL AND POLLUTIONALLY-DERIVED LIGNOCELLULOSIC DETRITUS IN WETLAND ECOSYSTEMS,
Georgia Univ., Athens. Dept. of Microbiology.
R. E. Hodson, A. E. Maccubbin, and R. Benner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-202333, Price codes: A04 in paper copy, A01 in microfiche. Environmental Resources Center Report Number ERC 03-82, Georgia Institute of Technology, Atlanta, December 1982. 58 p, 14 Fig, 5 Tab, 40 Ref. OWRT A-082-GA(1), 14-34-0001-9011.

Descriptors: *Detritus, Ecosystems, Effluents, *Lignocellulose, Pulp mill effluents, Radiolabelled lignocellulose, Wetland ecosystems, *Microbial degradation.

Wetlands have been characterized as detritus-based ecosystems. Most of the standing stock of plant biomass is not directly eaten by grazing animals, but first must be decomposed by the sediment and water microflora. In this study, the composition of a variety of wetland plants serving as sources of detritus was determined. Most of the dry weight was found to be lignocellulose. A radiotracer procedure was developed to specifically label the lignin and cellulosic moieties of lignocellulose from a variety of wetland plants. The labelled lignocelluloses were used in experiments to determine rates of detritus mineralization, solubilization, and conversion to microbial biomass under a variety of conditions characteristic of unstressed and polluted environments. Results indicate that low level pollutional stress can alter the rates and efficiencies of transformations of lignocellulosic detritus in wetland ecosystems.
W83-02913

SALINITY INVESTIGATIONS IN WEST SALT CREEK, COLORADO,
California Univ., Davis. Dept. of Land, Air and Water Resources.
L. D. Whittig, K. K. Tanji, J. W. Biggar, V. P. Evangelou, and A. E. Deyo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-203406, Price codes: A09 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, March 1983. 161 p, 46 Fig, 19 TTab, 87 Ref. OWRT B-201-CAL(2).

Descriptors: *Salinity, *Saline soils, *Erosion, *Shales, Colorado River, Salts, *Dissolved salts, West Salt Creek watershed, *Colorado, *Mancos shale, Non-point pollution sources.

This investigation was aimed at assessment of the potential for contribution of dissolved mineral salts to the Colorado River by natural forces for contribution of dissolved mineral salts to the Colorado River by natural forces acting within a small, representative watershed in the Upper Colorado River Basin. The 440 km super 2 West Salt Creek watershed in west central Colorado was chosen for the study. Certain geologic strata and geomorphic landforms were identified as major contributors of dissolved mineral salts, whereas others within the watershed contribute little to the salt load of streams of the area. The Late Cretaceous marine Manocs Shale, in particular, is a principal contributor of soluble salts. In many areas, however, the saline Mancos shale is effectively protected from erosion and salt release by surface coverings of sandstone cuestas and pediment surfaces. High salt-hazard areas within the watershed are delineated and mapped. (Snyder-California)
W83-02925

CONTAMINANT TRANSPORT IN FRACTURED POROUS MEDIA: ANALYTICAL SOLUTIONS FOR A SYSTEM OF PARALLEL FRACTURES,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
E. A. Sudicky, and E. O. Frind.
Water Resources Research, Vol 18, No 4, p 1634-1642, December, 1982. 7 Fig, 12 Ref.

Descriptors: *Solute transport, *Fracture permeability, Fate of pollutants, *Porous media, Radioactive wastes, Adsorption, Advection, Diffusion.

An exact analytical solution is developed for the problem of transient contaminant transport in discrete parallel fractures situated in a porous rock matrix. The solution takes into account advective transport in the fractures, molecular diffusion and mechanical dispersion along the fracture axes, molecular diffusion from the fracture to the porous matrix, adsorption onto the face of the matrix, adsorption within the matrix, and radioactive decay. The general transient solution is in the form of a double integral that is evaluated using Gauss-Legendre quadrature. A transient solution is also presented for the simpler problem that assumes negligible longitudinal dispersion along the fracture. This assumption is usually reasonable when the advective flux in a fracture is large. A comparison between two steady state solutions, one with dispersion and one without, permits a criterion to be developed that is useful for assessing the significance of longitudinal dispersion in terms of the overall system response. Examples of the solutions demonstrate that penetration distances along fractures can be substantially larger through multiple, closely spaced fractures than through a single fracture because of the limited capability of the finite matrix to store solute. (Author's abstract)
W83-02933

RADIUM, THORIUM AND RADIOACTIVE LEAD ISOTOPES IN GROUNDWATERS: APPLICATION TO THE IN SITU DETERMINATION OF ADSORPTION-DESORPTION RATE CONSTANTS AND RETARDATION FACTORS,
Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2K.
W83-02937

NUMERICAL SIMULATION OF FLOW AND CONTAMINANT MIGRATION AT AN EXTENSIVELY MONITORED LANDFILL,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
J. F. Sykes, S. B. Pahwa, R. B. Lantz, and D. S. Ward.
Water Resources Research, Vol 18, No 6, p 1687-1704, December, 1982. 17 Fig, 2 Tab, 14 Ref.

Descriptors: *Landfills, *Solute transport, *Model studies, Fate of pollutants, Leachates, Plumes, Canadian Forces Base Borden, *Ontario.

Leachate migration from the Canadian Forces Base Borden landfill, Ontario, was analyzed by a multidimensional finite-difference model for groundwater flow and contaminant transport. The site was used from 1942 to 1976 as a construction material dump and sanitary landfill. It is almost entirely above the water table. The model was validated by deriving parameters from laboratory

and field data. Small differences between measured and predicted piezometric surface were attributed to variations in potentiometric measurements, seasonal variations, and extrapolation of laboratory measurements to the field site. Variations in observed chloride-ion isopleths were typical of significant temporal plume behavior. Dispersivities were smaller than generally reported in the literature: longitudinal dispersivity, 5 m; transverse dispersivity, 0.1 m or less. Sensitivity simulations were done on the longitudinal and transverse dispersivities, imposed boundary condition potentials, hydraulic conductivity, landfill staging scheme, and sorption (potassium plume). (Cassar-FRC)
W83-02942

EDTA AS A KINETIC INHIBITOR OF COPPER(II) SULFIDE PRECIPITATION,
Maryland Univ., College Park. Dept. of Chemistry.
G. R. Helz, and L. M. Horzempa.
Water Research, Vol 17, No 2, p 167-172, February, 1983. 4 Fig, 1 Tab, 27 Ref.

Descriptors: *Wastewater treatment, *Chelating agents, *Chemistry of precipitation, Sulfides, Trace metals, Copper, Fate of pollutants, Radioactive wastes, Laboratory studies, Natural waters, Saturation, Supersaturation, *EDTA.

EDTA (ethylenediaminetetraacetic acid) is a synethetic chelating agent widely used as a detergent additive, food stabilizer, and cleansing agent in radiochemical laboratories. This substance, which appears to be only slowly degradable in the environment, has been found in wastewater treatment plants, rivers, and groundwaters near radioactive waste disposal sites in concentrations ranging from 0.1 to 10.0 micro-molar. Laboratory tests were conducted to determine the effects of the presence to EDTA on sulfide precipitation reactions. Even in billion-fold CuS- supersaturated solutions, EDTA was found to inhibit copper sulfide precipitation for periods of at least a few hours in some cases. The rate of precipitation increased with increasing total copper and sulfide, but decreased with increasing EDTA/copper ratio. The presence of colloidal sulfur was found to accelerate the precipitation rates in acidic solutions. The results indicate that EDTA may affect the behavior of sulfophile trace metals during wastewater treatment. It is speculated that some natural chelatants may also inhibit sulfide precipitation, thus accounting for a number of reports that sulfidic natural waters are grossly supersaturated with respect to sulfide minerals. (Carroll-FRC)
W83-02956

THE MEASUREMENT OF COMPLEXATION CAPACITY AND CONDITIONAL STABILITY CONSTANTS FOR LIGANDS IN NATURAL WATERS,
Procter and Gamble Co., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W83-02957

TOXICITY ASSESSMENT OF SNOWMELT WATER RUNOFF IN AN URBAN AREA (TOXICITE DES EAUX DE RUISSELLEMENT DE LA FONTE DE NEIGE EN MILIEU URBAIN),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5C.
W83-02958

SOME CHEMICAL CHARACTERISTICS OF MINE DRAINAGE IN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
L. G. Toler.
Available from Supt. of Documents, GPO Washington, DC 20402. Price $4.50. Geological Survey Water-Supply Paper 2078, 1982. 47 p, 10 Fig, 5 Tab, 8 Ref.

Descriptors: *Acid mine drainage, *Water quality, *Water pollution, *Streams, Strip mines, Sulfates, Sampling, Sites, Chemical analysis, *Illinois.

Surface mining for coal in Illinois has affected runoff from the mined areas and altered water quality in the streams. Average annual sulfate loads in streams are 3,000 to 4,000 tons per square mile to mined land in the Big Muddy and Saline River basins in southern Illinois. Relative high concentrations of dissolved aluminum, arsenic, chromium, copper, iron, manganese, and zinc are commonly associated with concentrations of sulfate greater than about 2,000 milligrams per liter. (USGS)
W83-02971

DELINEATION AND HYDROLOGIC EFFECTS OF A GASOLINE LEAK AT STOVEPIPE WELLS HOTEL, DEATH VALLEY NATIONAL MONUMENT, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
A. Buono, and E. M. Packard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-127548, Price codes: A13 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-45, July 1982. 23 p, 6 Fig, 2 Tab, 22 Ref.

Descriptors: *Groundwater pollution, *Alluvial aquifers, *Water supply, *Water pollution effects, Gasoline, Oil-water interfaces, Leakage, Infiltration, Path of pollutants, Groundwater movement, Soil contamination, *California, Death Valley National Monument, Stovepipe Wells Hotel.

Ground water is the only local source of water available to the Stovepipe Wells Hotel facilities of the Death Valley National Monument, California. A leak in a service station storage tank caused the formation of a gasoline layer overlying the water table, creating the potential for contamination of the water supply. The maximum horizontal extent of the gasoline layer was mathematically estimated to be 1,300 feet downgradient from the leaky gasoline tank. Exploratory drilling detected the gasoline layer between 900 and 1,400 feet downgradient and between 50 and 150 feet upgradient from the source. Traces of the soluble components of gasoline were also found in the aquifer 150 feet upgradient, and 250 feet distant from the source perpendicular to the direction of ground-water movement. The gasoline spill is not likely to have an effect on the supply wells located 0.4 mile south of the leak source, which is nearly perpendicular to the direction of ground-water movement and the primary direction of gasoline movement in the area. No effect on phreatophytes 2 miles downgradient from the layer is likely, but the potential effects of gasoline vapors within the unsaturated zone on local xerophytes are not known. (USGS)
W83-02982

HYDRODYNAMIC DISPERSION DURING UNSTEADY, UNSATURATED WATER FLOW IN A CLAY SOIL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2G.
W83-03001

POLLUTION OF GROUND WATERS BY CHLOROCHOLINE CHLORIDE USED IN AGRICULTURE (VOPROSY ZAGRYAZNENIYA GRUNTOVYKH VOD PRI PRIMENENII KHLORKHOLINKHLORIDA V SELYSKOM KHOZYAISTVE),
Moskovskii Gosudarstvennyi Meditsinskii Inst. (I) (USSR).
S. N. Cherkinsky, V. T. Mazaev, and V. E. Vasilenko.
Gigiena i Sanitariia, No 1, p 15-18, 1980. 1 Tab, 10 Ref.

Descriptors: *Groundwater pollution, *Chlorocholine chloride, *Agricultural runoff, Field tests, *Mathematical models, Precipitation, Precipitation intensity, Agriculture, Runoff, Model studies, Soil water, *Choline chloride, Trimethylamine hydrochloride, Chemical analysis, Water quality, Water pollution sources.

Experimental and field studies indicated that chlorocholine chloride (ChChCh) can migrate from the soil to groundwater in storm and irrigation water and that the extent of this migration depends on the level of precipitation. Data are presented on the stability of ChChCh in soil and water. Mathematical models are presented describing the processes of its breakdown and migration in soil. The degradation products of ChChCh in soil are choline chloride and trimethylamine hydrochloride. The models may be used to predict the degree of groundwater pollution in places where ChChCh is used agriculturally. If its concentration in a body of water does not exceed the established permissible level, the water quality importance of trimethylamine hydrochloride is very slight. (Author's abstract)
W83-03011

ORGANIC CARBON AND OXYGEN DEMAND RELATIONSHIPS IN STORMFLOW FROM SOUTHERN PINE WATERSHEDS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
J. D. Schreiber, and P. D. Duffy.
Soil Science Society of America Journal, Vol 46, No 1, p 142-148, January/February, 1982. 4 Fig, 6 Tab, 18 Ref.

Descriptors: *Organic carbon, *Sediment transport, *Storm runoff, Chemical oxygen demand, Oxygen demand, Storm water, Watersheds, *Forest watersheds, *Mississippi, Suspended sediments, Soil erosion, Erosion, Fate of pollutants, Organic matter, Soil organic matter, Runoff.

Stormflow from five undisturbed pine watersheds (1.5-2.8 ha) in Mississipi was analyzed for total organic carbon (TOC) and COD in solution and suspended sediment phases during the water years 1976, 1977, and 1978. Discharge weighted dissolved TOC levels were 6-16 mg per liter; dissolved COD, 20-45 mg per liter. The watersheds with soil organic matter contents in the higher portion of the 0.83-1.54% range had higher dissolved and sediment TOC and COD concentrations. Sediment TOC was 21,810-96,350 mg per kg; sediment COD, 62,600-233,340 mg per kg. TOC was enriched in the sediment compared with the soil by 3.5 to 10.1 times, depending on the specific soil. This was attributed to selective erosion of fine sediment and associated organic matter and/or deposition of coarse sediment in transport. The discharge weighted 5-day BOD in stormflow was very low, 6-11 mg 02 per liter, near the benchmark level recommended for protection of aquatic life. Of the total TOC transported (7.8-28.4 kg per ha per year) 60-77% was in the solution phase; the rest, associated with sediment. Rainfall input of TOC to the watersheds was 38-49 kg per ha per year. (Cassar-FRC)
W83-03015

HYGIENIC EVALUATION OF WATER POLLUTED BY PESTICIDES ENTERING WATER BODIES IN SURFACE RUNOFF (GIGIENICHESKAYA OTSENKA VODY, ZAGRYAZNENNOI NEKOTORYMI PESTITSIDAMI PRI POSTUPLENII IKH V VODOEM S POVERKHNOSTNYM STOKOM),
Kiev Inst. for Developmental Matters (USSR).
For primary bibliographic entry see Field 5C.
W83-03017

SALT GENERATION IN PYRITIC COAL SPOILS AND ITS EFFECT ON SATURATED HYDRAULIC CONDUCTIVITY,
Kentucky Agricultural Experiment Station, Lexington.
V. P. Evangelou, R. E. Phillips, and J. S. Shepard.
Soil Science Society of America Journal, Vol 46, No 3, p 457-460, May/June, 1982. 6 Fig, 6 Tab, 12 Ref.

Descriptors: *Hydraulic conductivity, *Coal mines, *Dissolved solids, Pyrite, Iron sulfide, Sulfides, Mine wastes, Strip mine wastes, Fate of pollutants, Oxidation, Infiltration, Laboratory studies, Soil chemistry, Solute transport, *Kentucky.

A laboratory column, 8.9 cm in diameter and 1 m long, was used to study the formation of soluble

salts by pyrite oxidation and the changes in hydraulic conductivity in a pyritic surface-mined coal spoil material from Kentucky. Upon leaching with water the hydraulic conductivity decreased from 0.50 cm per hour in the upper portion of the column to 0.03 cm per hour in the lower portion. Electrical conductivity, a measure of soluble salts, was 0.12 mmho per cm at the top of the column and 16.44 mmho per cm at the bottom. When all salts had been leached from the column, the hydraulic conductivity was nearly uniform throughout the column. (Cassar-FRC)
W83-03024

TRACE METAL COMPLEXATION BY FULVIC ACID EXTRACTED FROM SEWAGE SLUDGE: II. DEVELOPMENT OF CHEMICAL MODELS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito, F. T. Bingham, S. S. Yadav, and C. A. Inouye.
Soil Science Society of America Journal, Vol 46, No 1, p 51-56, January/February, 1982. 2 Fig, 3 Tab, 30 Ref.

Descriptors: *Chelation, *Metals, *Fulvic acids, Copper, Cadmium, *Trace metals, Sludge, Model studies, Soil chemistry, Speciation, Organic acids, Mixture Model, Fulvate Model, *GEOCHEM, Fate of pollutants.

Two chemical models for trace metal complexation by fulvic acid extracted from sewage sludge were compared using the computer program GEOCHEM. The Mixture Model is a set of 9 organic acids whose acidic functional groups exist in the fulvic acid fraction of sewage sludge and whose reactions with trace metals are well known. The Fulvate Model is composed of 18 metal-fulvic acid comlexes with stability constants that have been measured in the laboratory or estimated by linear correlation analysis. The two models disagreed significantly with predictions of the extent of organic complexation of Cu(++) and Cd(++) in 21 saturation extracts obtained from 3 acid soils amended with sewage sludge. The Mixture Model predicted that Cu(++) organic complexes would be the dominant fraction; the Fulvate Model predicted that Cu(++) would be dominant. Overall speciation of Cd(++) was similar for both models and for values measured with a Cd electrode. The differences between the results predicted from the two models is related to the competitive effects in the complexation of Cu(++), Mn(++), and Fe(++) by the organic ligands in each model. In the Mixture Model most stability constants for Cu-organic complexes are considerably larger than those for Mn or Fe complexes. In the Fulvate Model stability constants are about the same. (Cassar-FRC)
W83-03030

RADON, WATER, AND AIR POLLUTION: RISKS AND CONTROL,
Maine Univ. at Orono. Dept. of Physics and Astronomy.
For primary bibliographic entry see Field 5C.
W83-03031

NUTRIENTS AND ACID IN RAIN AND DRY FALLOUT AT FAYETTEVILLE, ARKANSAS (1980-1982),
Arkansas Univ., Fayetteville. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W83-03041

WATER QUALITY MODELING OF THE EQUUS BEDS AQUIFER IN SOUTH CENTRAL KANSAS,
Kansas Water Resources Research Inst., Manhattan.
M. A. Sophocleous, M. Heidari, and C. D. McElwee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208272, Price codes: A05 in paper copy, A01 in microfiche. Contribution No 231, December 1982. 68 p, 19 Fig, 2 Tab, 28 Ref. OWRT B-061-KAN(1), 14-34-0001-0263.

Descriptors: *Mass-transport models, Method of characteristics, *Finite element analysis, Finite difference, Groundwater flow model, Calibration, Multiple regression, Sensitivity analysis, Oil-field brines, *Groundwater quality, Equus beds aquifer, Wellington formation, Burrton oil-field, Wichita well-field, *Kansas, *Brine disposal.

The salinity problems created inthe Burrton area as a result of poor oilfield brine disposal practices of the past continue to be a major concern to the area depending on the Equus Beds aquifer for water, including the City of Wichita, Kansas. An attempt is made to predict where and how fast the brine plume will move in this area, and what the average chloride concentrations in different parts of the aquifer are. In order to made such predictions, it was necessary to get a calibrated model of the ground -water flow velocity field. Multiple regression analysis is used for parameter estimation of the steady-state groundwater flow equation applied in the most critical area of the Equus Beds aquifer. Results of such an analysis produced a correlation coefficient of 0.992 between calculated and observed values of hydraulic head. A choride transport modeling effort is then carried out despite some serious data deficiencies, the significance of which are evaluated through sensitivity analysis. Three mass-transport models employing a finite difference, a finite element and a method of characteristics approach are comparatively evaluated by applying them to the study area. It is concluded that in cases where the convection term predominates, as is the case with the study area, the method of characteristics is the better procedure to follow. Thus, starting with the quasi steady-state conditions of the early 1940's, it was possible to match the present chloride distribution satisfactorily. Chloride concentration predictions made for the year 2000 indicate that the quality of the Wichita well-field waters will not generally deteriorate from their present condition by that time.
W83-03042

TRANSPORT MODELING OF AN AGRICULTURAL PESTICIDE, PHASE I,
Kansas Water Resources Research Inst., Manhattan.
E. C. McCall, and D. D. Lane.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208280. Contribution No 229, October 1982. 37 p, 9 Fig, 4 Tab, 40 Ref, 2 Append. OWRT A-102-KAN(1), 14-34-0001-1118.

Descriptors: *Atrazine, *Pesticides, Pesticide simulation model, Runoff, Conservation practices, Model studies, *Agricultural runoff, *Simulation analysis, Watershed management, *Path of pollutants.

A field study to examine the transport of an agricultural pesticide during a runoff event was conducted. Data indicate that significant concentrations of atrazine are contained in the runoff water. Preliminary results indicate that even a very small buffer strip between the field and the receiving waters can significantly reduce the concentration of pesticide entering the receiving waters. A simple pesticide runoff simulation model was adapted for use on a small desk top computer. The model cannot predict runoff values exactly. It can, though, be used to obtain relative values to identify watersheds which most need attention and to evaluate the effects of different conservation practices when applied to a particular watershed.
W83-03043

VARIATIONS IN GROUNDWATER QUALITY WITH DROUGHT,
Kansas Water Resources Research Inst., Manhattan.
D. O. Whittemore, G. A. Marotz, and K. M. McGregor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208298, Price codes: A04 in paper copy, A01 in microfiche. Contribution No 228, September 1982. 57 p, 17 Fig, 6 Tab, 22 Ref.

Descriptors: Groundwater, *Groundwater quality, *Municipal water quality, *Drought, Climate, *Climatic index, *Kansas, Saline waters, Evapotranspiration, Recharge, Infiltration, Rainfall, Water Supply, Aquifers.

Large variations in the chemical quality of municipal groundwater supplies in Kansas occur in response to dry and wet conditions. These changes are explained by varying amounts of recharge available to dilute mineralized groundwaters. The Palmer Drought Index and Eagleman Aridity Index are the best measures of climatic conditions controlling groundwater-quality variations in Kansas. Two aquifer areas of Kansas were found to contain most of the municipal well-water supplies exhibiting highly significant correlations between quality and climatic variability. In east-central Kansas, from the Nebraska to the Oklahoma state lines, groundwater is found in Permian limestones. Where these limestones contain gypsum, the hardness, sulfate, and dissolved solids concentrations increase during extended dry periods. In south-central Kansas, where groundwaters in sand and gravel aquifers may be underlain by Permian rocks containing saltwater, concentrations of sodium, chloride, and total dissolved solids increase in some well waters during drought. A couple of municipal water supplies from aquifers overlying or in Cretaceous rocks in central and north-central Kansas also show variations in either sulfate or chloride contents with dry or wet spells. Deterioration in water quality can be estimated for droughts of differing severity using linear or curvilinear relationships between water chemistry records and a climate index. These relationships can be used to predict possible variations in present and future well-water supplies in the aquifer areas generally subject to these water-quality changes.
W83-03044

METABOLIC PROPERTIES OF THIOBACILLUS FERROOXIDANS ISOLATED FROM NEUTRAL PH MINE DRAINAGE,
Alaska Univ., Fairbanks. Inst. of Water Resources.
E. J. Brown, and J. M. Forshaug.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208306, Price codes: A04 in paper copy, A01 in microfiche. Completion Report 81-11, March 1983. 51 p, 13 Fig, 5 Tab, 82 Ref.

Descriptors: *Thiobacillus ferrooxidans, Mining, *Arsenic, *Acid mine drainage, Heavy metal leaching, *Alaska, Water pollution sources, Path of pollutants, Kinetics.

Thiobacillus ferrooxidans is found in heavy-metal contaminated drainages from placer and lode gold mines in many parts of Alaska and Canada. We have examined the iron-limited growth kinetics of a T. ferrooxidans isolate, AK1, using continuous cultures. AK1 is an arsenic tolerant isolate obtained from placer gold mine drainage containing large amounts of dissolved arsenic. The steady state growth kinetics can be described by a simple Monod equation modified for threshold ferrous iron concentrations. A supplement of 200 mg.l super -1 reduced a rsenic to the ferrous medium did not result in an increased steady state biomass nor did it appear to affect the steady state growth kinetics obtained in continuous cultures. Kinetic descriptions of the iron-limited growth of acidophilic iron-oxidizing bacteria are important for understanding the biogeochemical cycling of many metals and for application of these microorganisms to biohydrometallurgy.
W83-03045

TRANSPORT OF HEAVY METALS ON SUSPENDED SEDIMENTS UNDER HIGH FLOW CONDITIONS IN A MINERALIZED REGION OF WALES,
University Coll. of Wales, Aberystwyth. Dept. of Geography.
S. B. Bradley, and J. Lewin.
Environmental Pollution, Series B, Vol 4, No 4, p 257-267, 1982. 5 Fig, 2 Tab, 22 Ref.

Descriptors: *Metals, *Sediment transport, *Floods, Fate of pollutants, *Mine wastes, Heavy metals, Lead, Zinc, Cadmium, Iron, Sulfur, Phosphorus, Suspended sediments, Ystwyth River,

*Wales, Chemical precipitation, Adsorption, High flow.

Concentrations of Pb, Zn, Cd, Fe, S, and P on the surface of suspended sediments in the River Ystwyth, Wales, were determined over a 40 hour flood period June 1 to 3, 1981. Pb and Zn are supplied to the river by abandoned mines. During this flood the discharge peaked at 16 cumecs, 6 hours after the peak suspended sediment concentration of 70 mg per liter. Generally, the metals concentrations on the sediment surface decreased as discharge increased, due to dilution with clean sediment. On the falling limb of the hydrograph, sorption and coprecipitation by Fe/Mn complexes acted as a sink for the metals. The correlation of Pb and Zn levels with P and S levels suggests the formation of Pb and Zn phosphates and sulfides on the sediment surface. Total Pb and Cd on the sediment surface being transported was greatest during higher discharges, but total Zn transport was lower during high discharge, reaching a peak immediately after the discharge peak. (Cassar-FRC)
W83-03048

COMPUTATION OF THE INDEX OF POLLUTION CAUSED BY HEAVY METALS IN RIVER SEDIMENT,
Nippon Inst. of Tech., Saitama. Applied Statistics Lab.
H. Nishida, M. Miyai, F. Tada, and S. Suzuki.
Environmental Pollution, Series B, Vol 4, No 4, p 241-248, 1982. 2 Fig, 2 Tab, 9 Ref.

Descriptors: Metals, *Sediments, *Pollution index, Fate of pollutants, *Heavy metals, Rivers, *Japan, Estuaries, Copper, Zinc, Lead, Cadmium, Path of pollutants.

Heavy metals levels were measured in sediments from 92 Japanese rivers to develop an index of pollution (t) based on the idea that the upper 10% of the distribution of t for a standard group of rivers is considered polluted. Hydrochloric acid-soluble Cu, Zn, Pb, and Cd data from upstream sediments produced a critical point pollution value of 2.57 for the four heavy metals. Metals levels in the estuary sediments of the same rivers showed that 35 rivers had pollution indexes greater than 2.57. These polluted rivers included the Tama, Tsurumi, Syonai, and other urban rivers as well as rivers such as the Jintsu and Kitakami, passing through mining areas. In general the rivers of the Tohoku and Kanto districts, along the shore of the Seto Inland Sea, and along the Hokuriku coast had t values higher than 2.57. Most rivers in the Hokkaido and Sanin districts were considered unpolluted. (Cassar-FRC)
W83-03049

DETERMINATION OF NUTRIENT AND METAL RELEASE RATES IN SEDIMENTS FROM ENVIRONMENTALLY POLLUTED IMPOUNDMENTS OF RUNNING WATERS WITH THE AID OF INCUBATION EXPERIMENTS. PART 2: INVESTIGATIONS ON NITROGEN AND MANGANESE RELEASE (BESTIMMUNG VON NAHRSTOFF- UND METALLFREISETZUNGSRATEN AUS SEDIMENTEN UNWELTBELASTETER FLIESSGEWASSERSTAU-HALTUNGEN MIT HILFE VON INKUBATIONSVERSUCHEN. TEIL 2: UNTERSUCHUNGEN ZUR STICKSTOFF-UND MANGANFREISETZUNG),
Technische Univ., Dresden (German D.R.). Bereich Hydrobiologie.
J. Helbig, H. Reissig, and R. Holzig.
Acta Hydrochimica et Hydrobiologica, Vol 9, No 3, p 331-336, March, 1981. 2 Fig, 1 Tab, 8 Ref. (No English Summary).

Descriptors: *Reservoirs, *Fluvial sediments, *Nitrogen, *Manganese, *Free surfaces, Aerobic conditions, Anaerobic conditions, Ammonium, Nitrates, Denitrification, Hydrogen ion concentration, Incubation, Sediments, Oxidation, Water pollution, Nitrogen compounds, *German Democratic Republic, Kriebstein reservoir, Zwickauer Mulde river, Rochlitz storage reservoir.

Nitrogen and manganese release in sediments from the Kriebstein reservoir and the Rochlitz storage basin on the Zwickauer Mulde river (German Democratic Republic) was studied in long-term incubation experiments. During the initial phase of incubation of Kriebstein reservoir sediments (< 50 days), and intense ammonium release took place, caused by the escape of interstitial water in the course of sediment thickening. A simultaneous decrease in ammonium and increase in nitrate concentrations in the aerobic free water zone after day 6 indicated that nitrification began in the water at this time. Nitrate concentration decreased again on day 12 due to diffusion of nitrate into the sediment and associated denitrification. The mean nitrogen release rate was 10 mmol/sq m/day for the Kriebstein reservoir and 50-60 mmol/sq m/day for Zwickauer Mulde sediments. At Kriebstein, the decrease in nitrogen release rate with incubation time was markedly less under anaerobic than under aerobic conditions. In Zwickauer Mulde sediments, nitrogen release rates up to day 110 of incubation were 3.8 times higher than Kriebstein rates under aerobic conditions and 4.8 times higher under anaerobic conditions (for 10-cm sediment thicknesses). This was due to higher nitrogen contents in the original sediments from the Zwickauer Mulde (3.5 times higher for total nitrogen, 5.2 times higher for ammonium in the watery phase). For Kriebstein sediments, manganese release rates could be analyzed up to day 120 of incubation, the mean rate being 0.09 mmol/sq m/day. At Rochlitz, manganese release rates lay between 0.05 and 0.19 mmol/sq m/day under anaerobic conditions forthe 64-day incubation period and were dependent on sediment thickness (2, 10, or 25 cm). Under aerobic conditions, the mean rate was 0.05-0.32 mmol/sq m/day. This higher rate could be due to lower pH values in the oxidized upper layer (caused by nitrification). (Gish-FRC)
W83-03052

DETERMINATION OF NUTRIENT AND METAL RELEASE RATES IN SEDIMENTS FROM ENVIRONMENTALLY POLLUTED IMPOUNDMENTS OF RUNNING WATER WITH THE AID OF INCUBATION EXPERIMENTS. PART 1: DETERMINATION OF RATES OF PHOSPHORUS AND IRON RELEASE (BESTIMMUNG VON NAHRSTOFF- UND METALL-FREISETZUNGSRATEN AUS SEDIMENTEN UMWELTBELASTETER FLIESSGEWASSERSTAUHALTUNGEN MIT HILFE VON INKUBATIONSVERSUCHEN. TEIL 1: BESTIMMUNG VON PHOSPHOR- UND EISENFREISETZUNGSRATEN),
Technische Univ., Dresden (German D.R.). Bereich Hydrobiologie.
J. Helbig, H. Reissig, and R. Holzig.
Acta Hydrochimica et Hydrobiologica, Vol 9, No 2, p 203-212, February, 1982. 2 Fig, 6 Tab, 7 Ref. (No English Summary).

Descriptors: *Reservoirs, *Fluvial sediments, *Phosphorus, *Iron, *Anaerobic conditions, Aerobic conditions, Incubation, Sediments, Sediment-water interfaces, Oxidation, Dissolved oxygen, Water pollution, Organic matter, Limiting factors, *German Democratic Republic, Kriebstein reservoir, Zwickauer Mulde river, Rochlitz storage reservoir, *Path of pollutants.

Phosphorus (P) and iron (Fe) release from sediments in water from the Kriebstein reservoir and the Rochlitz storage basin on the Zwickauer Mulde river (German Democratic Republic) was studied in long-term incubation experiments. In the first stages of incubation (< 50 days), curves showing the cumulative release of P and Fe in relation to incubation time were similar for both aerobic and anaerobic incubation conditions. After this point, they began to diverge widely, with the curve for anaerobic conditions rising much more sharply. The reduction in release rate for aerobic incubation was due to an increase in thickness of the oxidized upper sediment layer: the thicker this layer, the longer was the time required for the transport through this zone of reducing substances from the deeper layers. P and Fe release rates for the Kriebstein reservoir could be divided into three categories: for the highly oxidized upper sediment layer, release rates for P and Fe, respectively, were 0.02-0.05 and 0.1 mmol/sq m/day; for the transition from aerobic to anaerobic conditions, rates were up to 5 and up to 25 mmol/sq m/day for P and Fe, respectively; for the permanently anaerobic upper sediment layer, rates were 0.1-0.3 and 0.5-1.5 mmol/sq m/day for P and Fe. The Zwickauer Mulde sediments contained higher levels of organic matter and presented more strongly limiting conditions, which impeded the formation of a permanently oxidized upper sediment layer. Release rates for these sediments could be divided into only two categories: for aerobic conditions in the sediment-water interface zone, release rates were 1-2 mmol/sq m/day for both P and Fe; while for anaerobic conditions in the sediment-water interface zone, they were 2-3 mmol/sq m/day for both P and Fe. (Gish-FRC)
W83-03053

THE INFLUENCE OF ADSORPTION ON GLASS, PH AND TEMPERATURE ON THE DISAPPEARANCE OF PERMETHRIN IN AQUEOUS SYSTEMS,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
M. S. Sharom, and K. R. Solomon.
Environmental Pollution, Series B, Vol 4, No 4, p 269-279, 1982. 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Insecticides, *Degradation, *Adsorption, Fate of pollutants, *Permethrin, *Pesticides, Temperature effects, Hydrogen ion concentration, Glass.

Factors affecting the adsorption and degradation of permethrin in water samples stored in glass containers were investigated. The fate of C14 labeled permethrin at a concentraton of 10 micrograms per liter in lake water was followed for 4 weeks under several treatments. Agitation of the sample bottles prior to residue analysis showed that loss of permethrin in azide-treated water (75% remaining after 4 weeks) and in untreated water (10% remaining after 4 weeks) was a result of degradation, with dichlorovinyldimethylcyclopropanedicarboxylic acid as the main metabolite. Degradation was much slower in azide-treated water, indicating that microorganisms have an important role in permethrin degradation. When bottles were not shaken prior to sampling, radioactivity in untreated water decreased to 71% at 1 week and rose to 95% at 4 weeks, showing adsorption of permethrin onto the glass surface (maximum at 1 week) and subsequent degradation. Radioactivity in the unshaken azide-treated samples was 65, 62, 48, and 47% at 0.5, 1, 2, and 4 weeks, respectively, the result of increased adsorption onto the glass walls and slower degradation. Degradation of permethrin at 4 and 15C was not greatly influenced by pH; 70% remained after 4 weeks. However, at 30C the insecticide degraded more rapidly at pH 4 and 9 than at pH 7. (Cassar-FRC)
W83-03057

WATER QUALITY IMPROVEMENT IN THE FIRTH OR FORTH: A DISCRIMINANT FUNCTIONAL ANALYSIS,
Napier Coll. of Commerce and Technology, Edinburgh (Scotland).
For primary bibliographic entry see Field 5G.
W83-03059

SORPTION AND SEDIMENTATION OF ZN AND CD BY SESTON IN SOUTHERN LAKE MICHIGAN,
Argonne National Lab., IL.
J. I. Parker, K. A. Stanlaw, J. S. Marshall, and C. W. Kennedy.
Journal of Great Lakes Research, Vol 8, No 3, p 520-531, 1982. 10 Fig, 2 Tab, 30 Ref.

Descriptors: *Lakes, Metals, *Plankton, *Zinc, *Cadmium, *Sorption, Seston, Sedimentation, Seasonal variations, Lake sediments.

The sorption and sedimentation of zinc and cadmium by southern Lake Michigan seston particles were investigated using Zn-65 and Cd-109 in 21 radiotracer experiments. The time-series sorption

by total seston greater than 0.45 micrometers was asymptotic, with apparent equilibria of about 100-200 ng Zn/L and about 1.0 to 2.0 ng Cd/L, occurring in 24-30 hr during the summer phytoplankton bloom. Studies of the sorption by different particle size fractions showed that the abundance of phytoplankton and detritus control the concentrations of particle-bound Zn and Cd. The seasonal maximum concentrations of particle-bound Zn and Cd correlated well with the development of both the summer and fall phytoplankton blooms. Serial additions of Zn and Cd in combination with the radiotracers showed that these additions inhibit the sorption of both metals as their toxic effects are expressed. Coupling of the particle-bound Zn and Cd estimates for the period May to December with data on the seasonal variations in the net settling velocity in southern Lake Michigan provided annual sedimentation rates of about 9 micrograms Zn/sq cm/yr and about 0.1 micrograms Cd/sq cm/yr that are in excellent agreement with similar estimates by other investigators. The experiments suggest that, if the dissolved concentrations of Zn and Cd do increase to toxic levels, the impacts on phytoplankton may potentiate further increases in the dissolved levels by reducing plankton sorption and removal by sedimentation. (Baker-FRC)
W83-03083

IDENTIFICATION OF TOTAL AND BIOLOGICALLY SENSITIVE FORMS OF TOXIC METAL INPUTS TO AN URBAN AFFECTED RIVER,
Washington Univ., Seattle. Fisheries Research Inst.
For primary bibliographic entry see Field 5A.
W83-03105

SEASONAL PATTERNS AND MOLECULAR WEIGHT VARIATIONS OF TRIHALOMETHANE PRECURSORS AND TRIHALOMETHANE FORMING POTENTIAL IN THE KAW RESERVOIR,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
J. N. Veenstra.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208884, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Oklahoma State Univ., Stillwater, March 1983. 53 p, 21 Fig, 5 Tab, 57 Ref. OWRT A-101-OKLA(1), 14-34-0001-1138.

Descriptors: *Ozonation, *Trihalomethanes, *Apparent molecular weight, *Seasonal variations, Ozone, Halogens, Reservoirs, Organic carbon, Humic acids, Pretreatment of water, Kaw Reservoir, *Oklahoma, Arkansas River.

The research involved looking at the seasonal variations over eleven months in the trihalomethane concentrations and the trihalomethane forming potential of water taken from the Kaw Reservoir, located on the Arkansas River in northern Oklahoma. The work also investigated seasonal variations in the quantity and apparent molecular weight of the organic precursors of trihalomethanes. Ozonation of Kaw Reservoir water was also looked at to determine its effect of the trihalomethane forming potential and the apparent molecular weight distribution of the naturally occurring organic compounds. During the study, ozonation caused a greater reduction in THMs than in TOC. The mean TOC reduction percentage was 9.4 + or - 22.9 while the mean percentage reduction in THM forming potential was 15.3 + or - 13.9. The results show that the ability of ozone to reduce the THM forming potential was sporadic, and its effect on the individual THMs varied with bromoform showing the smallest mean percentage reduction. The data showed a statistically significant difference between the THMs produced in the ozonated and unozonated samples. There was no correlation found between ozone dose and TOC, THM or U.V. absorbance reduction. The naturally occurring organic showed a predominance in the molecular weight range of 1000-5000. Seasonal shifts in the molecular weights of these organics were seen along with the ability of ozone to affect the shift.
W83-03108

FACTORS CONTROLLING BLUE-GREEN ALGAE DOMINANCE IN A SOUTHWESTERN RESERVOIR,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W83-03109

POTENTIAL ORGANOMETALLIC CARCINOGENS IN WASTEWATER EFFLUENTS FROM COAL GASIFICATION PLANTS,
North Dakota State Univ., Fargo. Dept. of Chemistry.
P. Boudjouk, and J. B. Woell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208900, Price codes, A06 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State University, Fargo, January 1983. 112 p, 3 Fig, 9 Tab, 88 Ref, 2 Append. OWRT B-059-NDAK(1).

Descriptors: Chemical reactions, Synthesis, *Organometallic complexes, Organic matter, *Organic compounds, Phenalene, Betones, Thiones, Coal gasification, Industrial wastewater, Carcinogens.

The syntheses of the first transition metal complexes of phenalene are described. The reaction of Fe sub 2(CO) sub 9 with phenalene gave n super 2-(phenalene) tetracarbonyliron (0) while n super 2-(phenalene)dicarbonylcyclopentadienyliron(I) tetrafluoroborate was prepared from phenalene oxide, Fe(CO) sub 2 Cp- and HBF sub 4. The photolysis of a hexane solution of phenalene and (Ch sub 3 C sub 5 H sub 4)Mn(CO) sub 3 gave n super 2-(phenalene)dicarbonyl(methylcyclopentadienyl) manganese(O). A new synthesis of cycloprop(a)acenaphthylene, the valence isomer of phenalene, was developed. Fe(CO) sub 2 Cp(isobutylene) super + BF sub 4- was found to catalytically isomerize cycloprop(a)acenaphthylene to phenalene, representing one of only a few examples of catalytic activity by the Fe(CO) sub 2 Cp super + moiety. The mechanism of this reaction was explored and isotopic studies suggested that an intermediate in this isomerization was fluxional with the iron hopping from ring to ring. Dicarbonylcyclopentadienyliron(I) complexes of very basic ketones and thiones were prepared. The x-ray structure of the tropone and diphenylcyclopropenethione showed these complexes to be O and S bound, respectively. These structures also showed that the positive charge of the Fe(CO) sub 2 Cp super + moiety was not delocalized on to the ketone and thione ligands. The preparation of one of these complexes, (diphenylcyclopropenone)dicarbonylcyclopentadienyliron(I) tetrafluoroborate, was the first example of a complex of this ketone without ring opening. The reaction of Fe(CO) sub 2 Cp(isobutylene) super + BF sub 4 super - with thiobenzophenone gave only the S bound complex and no ortho-metalation was observed.
W83-03110

THE EFFECTS OF PH AND REDOX POTENTIAL ON THE RELEASE OF HEAVY METALS FROM ARKANSAS RIVER SEDIMENTS,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
M. H. Bates.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-209023, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Oklahoma State Univ., Stillwater, March 1983. 41 p, 9 Fig, 1 Tab, 69 Ref.

Descriptors: Copper, Cadmium, Chromium, Lead, Zinc, *Oxidation-reduction potential, *Sediments, Rivers, Atomic absorption spectrophotometry, *Heavy metals, *Hydrogen ion concentration, *Arkansas River, *Oklahoma, Tulsa, Sediment analysis, Path of pollutants.

The release of copper, cadmium, chromium, lead and zinc from sediments obtained from the Arkansas River in Tulsa, Oklahoma was examined in laboratory systems at various pH and oxidation-reduction potential values. Maximum release of the metals as a function of pH occurred either in the very acidic or the very alkaline pH range, and it is therefore, unlikely that a significant release of the metals would be observed in situ for an extended period of time. Anaerobic conditions promoted the release of copper, and lead, and zinc although aerobic release was also observed. The release of cadmium was not significantly affected by varying the redox potential, and the release of chromium was found to increase with an increase in the oxidation-reduction potential.
W83-03112

TOXIC SUBSTANCE MODELS FOR THE UPPER MISSISSIPPI AND MISSOURI RIVERS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. R. Giaquinta.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-209049, Price codes: A04 in paper copy, A01 in microfiche. IIHR Report No 95, August 1982. 58 p, 19 Fig, 2 Tab, 8 Ref, 2 Append. OWRT B-069-IA(1), 14-34-0001-9149.

Descriptors: *Mathematical model, Toxic chemicals, Water quality, *Convection, *Diffusion, Rivers, Model studies, *Path of pollutants, *Missouri River, Upper Mississippi River, *Finite difference methods.

A time variable model for the solution of the two-dimensional convection-diffusion equation in curvilinear coordinates was developed. The model was a finite difference scheme to solve the convection-diffusion equation using the alternating direction implicit (ADI) method. The model applies to the discharge of conservative substances and to simple first-order, decaying toxic chemicals. A dye study, conducted by the U.S. Army Corps of Engineers on a 27 mile reach of the Missouri River, was used for verification of the model. The model results were in good agreement with the field data.
W83-03114

SOURCES, SINKS, AND STORAGE OF RIVER SEDIMENT IN THE ATLANTIC DRAINAGE OF THE UNITED STATES,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2J.
W83-03117

TURBIDITY IN THE WESTERN BASIN OF LAKE ERIE,
Environmental Protection Agency, Narragansett, RI.
For primary bibliographic entry see Field 2J.
W83-03118

THE IMPACT OF ENERGY DEVELOPMENT IN THE TONGUE RIVER BASIN, SOUTHEASTERN MONTANA,
Ohio Wesleyan Univ., Delaware. Dept. of Geography and Geology.
For primary bibliographic entry see Field 4C.
W83-03139

AN EXAMINATION OF LAND USE - NUTRIENT EXPORT RELATIONSHIPS,
Kentucky Natural Resources and Environmental Protection Cabinet, Frankfurt. Div. of Water.
M. N. Beaulac, and K. H. Reckhow.
Water Resources Bulletin, Vol 18, No 6, p 1013-1024, December, 1982. 6 Fig, 2 Tab, 75 Ref.

Descriptors: *Land use, *Nutrients, *Nonpoint pollution sources, Fate of pollutants, Water pollution sources, Forest watersheds, Agricultural watersheds, Urban watersheds, Nitrogen, Phosphorus, Runoff, Climates, Fertilizers, Soil types, Farm wastes, Farm management, Pastures, Feedlots, Manure, Reviews, Watershed management.

A literature review of nutrient export studies relates land use to fluxes of phosphorus and nitrogen.

The magnitude of nutrient flux is influenced by land use (considered here are forest, agricultural, and urban watersheds) in general and by soils, climate, and land cover management practices in particular. Nutrient export from forest land is low and homeostatic; from urban watersheds, high and widely variable. In forest land higher nutrient loads result from hardwood watersheds than from softwood watersheds, from loams and sedimentary formations rather than sand overlying granites, and from glaciated regions. Nutrient flux is greater in warm humid climates than in drier climates. In agricultural lands the factors promoting high nutrient loads are fallow land, clay or organic soils, application of fertilizers before or during high runoff periods, over- or under- fertilization, row cropping, poor infiltration, high farm animal density, lack of detection basins, and a greater proportion of nitrogen-fixing crops. Sources of nutrients in urban areas are impervious surfaces, atmospheric emissions, deicing chemicals, street dirt, construction site erosion, industrial spills, and illegal wastewater discharges. As watersheds become increasingly removed from the natural state and the degree of human pertubation increases, the ability to predict the interactions between land use and response of water bodies becomes less precise and more difficult. (Cassar-FRC)
W83-03144

A MODELING APPROACH FOR STORM WATER QUANTITY AND QUALITY CONTROL VIA DETENTION BASINS,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W83-03147

5C. Effects Of Pollution

THE INFLUENCE OF SEX, SIZE, AND SEASON ON MIREX LEVELS WITHIN SELECTED TISSUES OF LAKE ONTARIO SALMON,
O.H. Materials Co., Findlay, OH.
S. E. Insalaco, J. C. Makarewicz, and J. N. McNamara.
Journal of Great Lakes Research, Vol 8, No 4, p 660-665, 1982. 2 Fig, 2 Tab, 34 Ref.

Descriptors: *Mirex, *Pesticides residues, *Fish, Fate of pollutants, *Salmon, *Lake Ontario, Insecticides, Sport fishing, Seasonal variation, Organochlorine pesticides.

Mirex concentrations were determined in tissues of coho (Oncorhynchus kisutch) and chinook (O. tschwaytscha) salmon collected from Lake Ontario during spring and autumn of 1977 and 1978. The range of mirex levels was 0.05 to 0.42 mg per kg, with no significant difference between coho and chinook salmon. Mean mirex levels (mg per kg) in the tissues of 24 fish sampled were: fillet, 0.22; belly flap, 0.22; skin, 0.21; red muscle, 0.17; dorsal loin, 0.12; and caudal peduncle, 0.12. Statistically, the tissues were grouped according to similar mirex levels as follows: fillet/belly flap/skin; red muscle; and dorsal loin/caudal peduncle. In general, mirex concentrations increased with individual fish weight and appeared to parallel the lipid concentrations of tissues. Mirex concentrations were statistically different between sexes and seasons in some tissues, but no pattern was evident. By selectively removing the red muscle, belly flap, and skin from the fish fillet before consumption, the mirex levels in the edible portion can be reduced by 56%. (Cassar-FRC)
W83-02841

ORGANOCHLORINE AND HEAVY METAL RESIDUES IN STANDARD FILLETS OF COHO AND CHINOOK SALMON OF THE GREAT LAKES - 1980,
Michigan Dept. of Natural Resources, Lansing. Office of Toxic Materials Control.
T. K. Rohrer, J. C. Forney, and J. H. Hartig.
Journal of Great Lakes Research, Vol 8, No 4, p 623-634, 1982. 5 Fig, 3 Tab, 40 Ref.

Descriptors: Fish, Metals, *Pesticide residues, Fate of pollutants, *Heavy metals, *Organochlorine pesticides, *Salmon, Great Lakes, Lake Michigan, Polychlorinated biphenyls, DDT, Dieldrin, Mercury, Bioaccumulation, Accumulation, Zinc.

Coho and chinook salmon collected in the fall of 1980 from 7 Michigan tributaries to the Great Lakes contained (in standard skin-on fillets) polychlorinated biphenyls (PCB), DDT, dieldrin, zinc, and mercury, but no detectable aldrin, chlordane, heptachlor, heptachlor epoxide, toxaphene, arsenic, cadmium, chromium, copper, or lead. Total DDT levels were 0.06-2.27 mg per kg in coho salmon and 0.29-3.40 mg per kg in chinook salmon; no fish specimens were above the FDA action level of 5 mg per kg total DDT for fillets. These values were 75% less than DDT levels in similar fish examined in 1971. PCB (Aroclor 1254 predominating) concentrations were 0.66-6.10 mg per kg in coho and 2.0-16.0 mg per kg in chinook. Six of the 63 coho and 29 of the 50 chinook had total PCB levels exceeding the FDA action level of 5 mg per kg. The maximum dieldrin residue was 0.17 mg per kg (FDA action level, 0.3 mg per kg). Mercury residues were none detected to 0.35 mg per kg in coho and 0.15-0.55 mg per kg in chinook (FDA action level, 1 mg per kg). In general, chinook salmon had higher contaminant levels than coho salmon collected at the same time and place. Most highly contaminated fish were found in the St. Josephs River tributary (most southern station); least contaminated fish were from Lake Erie tributaries (Huron River). PCB and DDE residues were strongly correlated. Skinless fillets had about half the DDT levels and about 1/4 the PCB levels of skin-on fillets. (Cassar-FRC)
W83-02843

THE IMPACT OF DIFFUSE ATMOSPHERIC NUTRIENT LOADING ON AN OLIGOTROPHIC FRESHWATER LAKE IN A DEVELOPING URBAN AND INDUSTRIAL AREA (RICHARDS BAY, SOUTH AFRICA),
National Inst. for Water Research, Congella (South Africa). Natal Regional Lab.
C. G. M. Archibald, and M. S. Muller.
Water Science and Technology, Vol 14, No 9-11, p 1533-1534, 1982.

Descriptors: Water quality, *Water pollution effects, *Oligotrophic lakes, Lakes, Industrial wastes, *South Africa, Richards Bay, Nutrients, Algal blooms, Lake Mzingazi.

Lake Mzingazi is a large natural freshwater lake in the Richards Bay area, currently the only existing supply of water for the area or a new harbor. The small seaside resort of Richards Bay has expanded rapidly since 1970. Industrial developments have included a coal terminal construction, an aluminum smelter and a phosphoric acid factory. An algal bloom dominated by Anabaenopsis raciborskii developed in the lake during spring and summer of 1978, following the initial industrial period. Chlorophyll a levels in the lake rose sharply, from 11 to 33 micrograms/liter. A study of the lake indicated that atmospheric nutrient inputs constituted about 67.3% of the annual phosphorus load and 69.1% of the annual nitrogen load. Changes in the pattern of the atmospheric nutrient input may therefore be expected to have a great impact on the lake. (Baker-FRC)
W83-02850

THE STRIPED BASS DECLINE IN THE SAN FRANCISCO BAY-DELTA ESTUARY,
J. F. Arthur, L. W. Botsford, T. Cannon, G. C. Cox, and S. R. Hansen.
Report to the California State Water Resources Control Board, Sacramento, November 1982. 58 p, 27 Fig, 2 Tab, 32 Ref, 1 Append.

Descriptors: *Bass, *Photoplankton, *Fish eggs, *Fish diets, *Fish toxins, Heavy metals, Zinc, Petroleum hydrocarbons, Zooplankton, Fish farming, *California, San Francisco Bay-Delta estuary.

The adult population of striped bass is only one-quarter of what it was twenty years ago, and the production of young over the past five years is one-third to one-half of the expected values. The cause is most likely one or more of the following factors: reduced plankton food supply for the young in the western Delta and Suisun Bay, probably as a result of export pumping of water by the CVP/SWP; entrainment in diversions; inadequate egg production; and high levels of toxic substances. Petroleum hydrocarbons and zinc are strongly implicated as having adverse effects on the reproductive capacity and fitness of adult spawning striped bass. The bass eggs also contain significantly higher amounts of pesticides and PCBs than those from Coos River, Oregon; levels equal and exceed those reportedly causing poor survival of the early life stages of the other species. More intensive toxicant monitoring is recommended. To mitigate the reduced egg production, it is suggested that catching female bass be reduced. Hatchery production may also be useful. The study group agreed that entrainment losses in diversions are unlikely to be the cause of the recent bass decline but that they do contribute to the losses. The mose probable cause for the decline is inadequate food supply; phytoplankton necessary for the development of zooplankton has been extremely low. The reduced and delayed production may be related to the use of Delta channels to convey water to the CVP/SWP export pumps in the South Delta. An export reduction to 2500 cfs in late spring is recommended. (Atkins-Omniplan)
W83-02919

WASTE FROM THE WATER TREATMENT PLANT AT ALTON AND ITS IMPACT ON THE MISSISSIPPI RIVER,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W83-02920

METABOLISM OF CALIFORNIA STREAM FISHES,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
J. J. Cech.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206284, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center, Completion Report, Univ. of California, Davis, April 1983, 27 p, 8 Tab, 17 Ref. OWRT A-082-CAL(1).

Descriptors: *Fish, Trout, Sucker, Sculpin, Perch, Roach, *Oxygen requirements, *Metabolism, *California.

Respiratory metabolic (oxygen consumption) rates were measured for rainbow trout, Sacramento squawfish, Sacramento sucker, hardhead, tule perch, riffle sculpin, and California roach at acclimated temperatures of 10, 20, 30C and two levels of dissolved oxygen: Normoxia (air-saturated) and hypoxia (about 25% of the oxygen concentration at full air saturation). After an overnight 5C temperature elevation, oxygen consumption rates were measured again at the same two dissolved oxygen levels, to better understand the effects of short- and long-term environmental changes resulting from altered stream flows. In general, all seven species increased their respiratory metabolic (= food and oxygen) requirements with acclimation and short-term temperature elevations. Additional data from Sacramento squawfish acclimated to 15 and 25C revealed that short-term temperature elevations increase metabolism to higher rates than does long-term acclimation at the same temperatures. Comparative, mass-independent metabolic rates at 20C showed rainbow trout > Sacramento squawfish > Sacramento suckers, hardhead and tule perch > Calif. roach and riffle sculpin. Stream flow reductions, causing warmed and/or hypoxic conditions would produce predictable effects on California stream fish communities from the collected metabolic and mortality data. In general, the most sought-after sportfishing species (rainbow trout) would be the first species with physiological and survival problems, and California roach would be the last. (Snyder-California)
W83-02944

PHYSICAL AND CHEMICAL PROPERTIES OF POND WATERS RECEIVING WARM-WATER EFFLUENT FROM A THERMAL POWER PLANT,

Jyvaeskylae Univ. (Finland). Dept. of Biology.
P. V. Eloranta.
Water Research, Vol 17, No 2, p 133-140, Febuary, 1983. 11 Fig, 2 Tab, 14 Ref.

Descriptors: *Cooling water, *Thermal pollution, *Stratification, Water pollution effects, Ponds, Ice cover, Water temperature, Thermal powerplants, Temperature, Powerplants, Thermal stratification, Vasikkalampi Pond, *Finland, Oxygen depletion, Water quality, Phytoplankton.

Cooling water discharged from a 35 MW thermal powerplant into Vasikkalampi Pond, Finland, 30,700 sq m in area and 115,000 cu m in volume, affected the physical and chemical properties of the pond water. The powerplant, which supplies heat for urban homes,operates only during September through May. Cooling water is removed from the middle of the pond and returns to the northern end as a spray. The major changes caused by the heated effluent were: (1) a shortened ice cover period (only short periods during December through March) and (2) increase of the normal 3-month chemical and thermal stratification period to 6-7 months (April-October). The stratification depleted oxygen in the hypolimnion. Secchi disc transparencies varied from 0.4 to 3.5 mm and were highest in winter and lowest in June. Levels of silica, phosphates, and total phosphorus, highest in February, were closely and inversely correlated with growth of algae and macrophytes. (Cassar-FRC)
W83-02954

TOXICITY ASSESSMENT OF SNOWMELT WATER RUNOFF IN AN URBAN AREA (TOXICITE DES EAUX DE RUISSELLEMENT DE LA FONTE DE NEIGE EN MILIEU URBAIN),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard.
Water Research, Vol 16, No 7, p 1197-1205, July, 1982. 1 Fig, 3 Tab, 50 Ref. English summary.

Descriptors: *Bioassay, *Chlorophyta, *Water pollution effects, *Snowmelt, *Urban areas, Thaw, Rainfall, Surface runoff, Outfall sewers, Sewers, *Toxicity, Lead, Phosphorus, Chloride, Biochemical oxygen demand, Nitrate, Chromium, Zinc, Suspended solids, Inorganic compounds, Montreal, Quebec, Canada.

Bioassays were conducted on the green alga Selenastrum capricornutum to evaluate the composite effect of all pollutants occurring in waters originating from melting snow in urban areas. Also, the long-term bioavailability of selected toxicants in these waters was determined. A sampling study was performed on two outfalls of Montreal sewer systems of the combined surface runoff-wastewater type. Sampling was carried out in the spring of 1978 and was directed towards an analysis of flow-quality relationships during two dry and three snowmelt periods. Water quality parameters studied included: BOD5, COD, Cl(-), N, P, Pb, Cr, Zn, CN(-), and SS. Toxicological qualities of the outfalls were determined using a bioassay based on the fertility potential of Selenastrum capricornutum. An analysis of the relationship between chemical quality and the toxicological properties of the samples from both sewage networks indicated that water collected during snowmelt without rain had a greater potential for chronic toxicity and greater mean ratios of biomass after incubation in presence of EDTA to biomass without EDTA than combined water collected during dry weather. The toxicity resulted primarily from inorganic compounds. Rain during snowmelt apparently diluted the toxicants. (Small-FRC)
W83-02958

THE HEALTH SIGNIFICANCE OF VIRUSES IN WATER.
For primary bibliographic entry see Field 5F.
W83-02959

SOME CHEMICAL CHARACTERISTICS OF MINE DRAINAGE IN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W83-02971

DELINEATION AND HYDROLOGIC EFFECTS OF A GASOLINE LEAK AT STOVEPIPE WELLS HOTEL, DEATH VALLEY NATIONAL MONUMENT, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W83-02982

ATYPICAL MYCOBACTERIA ISOLATED AT CATANIA (MICROBATTERI ATIPICI ISOLATI A CATANIA),
Catania Univ. (Italy). Cattedra di Dermatologia Pediatrica.
For primary bibliographic entry see Field 5A.
W83-03009

HYGIENIC EVALUATION OF WATER POLLUTED BY PESTICIDES ENTERING WATER BODIES IN SURFACE RUNOFF (GIGIENICHESKAYA OTSENKA VODY, ZAGRYAZNENNOI NEKOTORYMI PESTITSIDAMI PRI POSTUPLENII IKH V VODOEM S POVERKHNOSTNYM STOKOM),
Kiev Inst. for Developmental Matters (USSR).
P. I. Kosachevskaya.
Gigiena i Sanitariia, No 6, p 8-11, 1980. 3 Ref. English summary.

Descriptors: *Pesticides, *Surface runoff, *Oxidation, *Water pollution sources, *Agriculture, Agricultural runoff, Runoff, Water quality, Chloramp, Banvel-D, Chemical analysis, *USSR.

A formulation of the pesticides Chloramp and Banvel-D, when present in a body of water, activates biochemical oxidation processes to a greater degree than do the active principles of these pesticides in the same concentration. After entering a water body in a near-threshold concentration (as estimated on an organoleptic basis), the tested mixtures of pesticides will undergo biochemical oxidation, resulting in reduced levels of dissolved oxygen in the water and in a deteriorated sanitary condition of the water body. The treatment of plants with a mixture of these pesticides at rates of 0.3 kg/hectare of Chloramp and 5 kg/hectare of Banvel-D (the rates now considered to be most effective) may impair the water quality of the water body if the pesticides reach the water through surface runoff. (Author's abstract)
W83-03017

SOIL PORE STRUCTURAL STABILITY AND IRRIGATION WATER QUALITY: I. EMPIRICAL SODIUM STABILITY MODEL,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science and Agrometeorology.
For primary bibliographic entry see Field 2G.
W83-03027

RADON, WATER, AND AIR POLLUTION: RISKS AND CONTROL,
Maine Univ. at Orono. Dept. of Physics and Astronomy.
C. V. Weiffenbach.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206789, Price codes: A04 in paper copy, A01 in microfiche. Land and Water Resources Center Completion Report, Univ. of Maine, Orono, November 1982. 48 p, 14 Fig, 6 Tab, 1 Append, 60 Ref. OWRT A-057-ME(1), 14-34-0001-2121.

Descriptors: Air pollution, *Radiation, *Radioactivity effects, Water supply, Well water, *Maine, *Radon, Public health, Path of pollutants, Water pollution sources, Pollutant identification.

Summaries are presented on: (1) what is known about sources, levels, and health effects of radon; (2) how homeowners can have their water and air tested for radon; and (3) how radon levels in the home can be reduced. In Maine, radon levels were found to be highest in granitic regions (with well water averaging 22,000 pCi/1). Health risks from airborne radon are substantially greater than those from waterborne radon. It is estimated that a person living for sixty years in a house with an airborne radon level of 4 pCi/1 would have one chance in 100 of dying from lung cancer from that cause. The key factors affecting airborne radon levels in a home include (1) radon levels in well water, and water-using habits; (2) radon levels in soil gas, and type of construction of house and foundation; and (3) house ventilation rates. Effective control measures include use of activated carbon filters and increased ventilation pf the building.
W83-03031

STATISTICS OF SPECIES ABUNDANCE DISTRIBUTIONS IN MONITORING AQUATIC COMMUNITIES,
Idaho Univ., Moscow. Dept. of Forest Resources.
B. Dennis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206821, Price codes: A03 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Moscow, March 1983. 21 p, 22 Ref. OWRT A-085-IDA(1), 14-34-0001-2114.

Descriptors: *Aquatic environment, *Aquatic populations, *Species abundance distributions, *Aquatic biological communities, *Statistical methods, Statistical models, Probability, Water pollution effects, Model studies.

Statistical procedures were established for using species abundance distributions for monitoring pollution impacts in aquatic biological communities. The report synthesizes the statistical theory necessary for conducting inferences with community abundance data. Previous use of species abundance distributions by ecologists has relied on largely ad hoc analysis procedures. Instead, this report recommends: 1) the sampling distribution be fully specified, and 2) maximum likelihood (ML) techniques for parameter estimation be used. Two particular abundance distributions, the gamma and the lognormal, appear to be useful provided the above recommendations are followed. The so-called Canonical Hypothesis places restrictions on the parameter values for the gamma or lognormal models. This hypothesis can be explicitely tested for most data sets uing the ML estimation techniques. Other hypotheses that can be tested with these techniques are: 1) goodness-of-fit, for evaluating the model's description of the data, 2) two-sample for comparing two communities, and 3) likelihood ratio, for testing simple vs. complex models.
W83-03035

ULTRASONIC TELEMETRY STUDIES OF FISH ACTIVITY NEAR THE NANTICOKE THERMAL GENERATING STATION,
Ontario Ministry of Natural Resources, Port Dover.
N. G. MacLean, G. C. Teleki, and J. Polak.
Journal of Great Lakes Research, Vol 8, No 3, p 495-504, 1982. 5 Fig, 4 Tab, 32 Ref.

Descriptors: *Fish, *Thermal pollution, Heated water, Effects of pollution, Temperature effects, Waste heat, Thermal powerplants, *Lake Erie, Lakes.

Ultrasonic telemetry studies were conducted in 1973-77 to determine the effects of Nanticoke Thermal Generating Station's warmwater discharge on movement patterns of smallmouth bass, rock bass, and yellow perch. A total of 74 fish were tracked in the effluent plume and at control locations. These fish were monitored continuously, recording position, distance between turns, swim speed and angle of course alteration, as well as various environmental parameters. An activity index was developed to measure the overall level of fish activity. The measured activity of all three species was significantly lower within the plume than outside of it. Water depth appeared to be the most important factor determining fish activity, followed by wave height, current speed, and tem-

perature. Wave height, current speed, and temperature are directly affected by the thermal discharge. However, on closer examination, the response to the plume appeared to have been principally rheotactic. No long term residency in the plume was noted during this study or during concurrent make-recapture studies. (Baker-FRC)
W83-03074

IMPACT OF POWER PLANT ENTRAINMENT OF ICHTHYOPLANKTON ON JUVENILE RECRUITMENT OF FOUR FISHES IN WESTERN LAKE ERIE IN 1975-77,
Michigan Univ., Ann Arbor. School of Natural Resources.
R. L. Patterson, and K. D. Smith.
Journal of Great Lakes Research, Vol 8, No 3, p 558-569, 1982. 8 Tab, 20 Ref.

Descriptors: *Powerplants, *Entrainment, *Fish, Population dynamics, Population density, Model studies, Sampling, Ichthyoplankton, *Lake Erie.

The impact was assessed of power plant entrainment of ichthyoplankton in western Lake Erie on juvenile recruitment to fish populations of the same region. Extensive ichthyoplankton surveys of western Lake Erie were conducted over a 3 yr period. Of the four species studied: gizzard shad, white bass, walleye, and freshwater drum, it was found that the effect on walleye year class strength is minimal, while the effect on gizzard shad recruitment may possibly be significant in terms of overall impact on the community ecology of the western basin. This aspect of the plant should be further studied. It was estimated that total juvenile recruitment of these four species would increase by 742 individuals per acre if all power plant entrainment were eliminated. (Baker-FRC)
W83-03075

THE RELATIONSHIP OF MINERALS COMMONLY FOUND IN DRINKING WATER TO ATHEROSCLEROSIS AND HYPERTENSION IN PIGEONS,
Oak Ridge Research Inst., TN.
N. W. Revis, R. L. Schmoyer, and R. Bull.
Journal of the American Water Works Association, Vol 74, No 12, p 656-659, December, 1982. 5 Fig, 3 Tab, 7 Ref.

Descriptors: *Public health, *Cardiovascular disease, *Minerals, Lead, Cadmium, Magnesium, *Hypertension, *Atherosclerosis, Pigeons, Calcium, Drinking water, Hardness.

The effects of Ca, Cd, Pb, and Mg in drinking water on cardiovascular disease were examined in white Carneau pigeons. The effects were expressed in terms of blood pressure and the presence and severity of atherosclerosis in pigeons from each of 16 experimental groups. The cardiovascular effects of Pb and Cd and the tissue levels of these elements depend on the level of Ca. The presence or absence of Mg did not significantly influence the cardiovascular effects of Pb or Cd following 24 months of exposure. If these results with the pigeons can be extrapolated to humans, the incidence of aortic atherosclerosis and hypertension should be significantly higher in geographic regions where there is a high intake of Pb and Cd and a low intake of Ca. The lack of a consistent and significant negative correlation between hard water and cardiovascular diseases may be the result of the relative level of Ca found in these hard waters. Harder water may reduce the intestinal absorption of Cd or Pb, which should result in a lower incidence of cardio vascular disease. (Baker-FRC)
W83-03081

EVALUATING POTENTIAL HEALTH RISKS OF CONSUMING REUSED WATER,
Chemical Industry Inst. of Toxicology, Research Triangle Park, NC.
R. A. Neal.
Journal of the American Water Works Association, Vol 72, No 12, p 638-641, December, 1982. 14 Ref.

Descriptors: *Public health, *Reclaimed water, Water supply, Water resources development, Drinking water, Potable water, Industrial wastes, Municipal wastewater, Wastewater treatment, Particulates, Asbestos, Metals, Organic compounds, Radiochemicals, Water reuse.

The possible adverse health effects caused by human consumption of reused water are surveyed, and suggestions for laboratory animal tests to evaluate chemical constituents of the water are outlined. Such analyses are needed before water treatment processes can be adjusted to accommodate reused water and monitoring procedures can be established to assure its safety. The major concern about reclaiming water for potable use is whether there is any significant health risk attributable to consumption of this water because of its bacteria, virus, or chemical content. The suspended particulate of greatest health concern is asbestos. Inorganic anions and cations of concern include sodium, arsenic, barium, cadmium, chromium, lead, mercury, silver, selenium, fluoride, nitrate, copper, iron, manganese, sulfate, and zinc. Methods are briefly described for evaluating acute toxic effects of inorganic chemicals, radiochemicals, particulates and organic chemicals; for evaluating subchronic effects of contaminants; and for evaluating chronic health effects as well. Teratogenicity and reproductive studies are needed along with tests of the effects on the immune system. The best continuous monitoring procedure to follow in regard to the introduction of new chemicals into the water supply is analytical monitoring of the supply and a continuous evaluation of new compounds introduced from industrial, agricultural, and household discharge into the source waters. (Baker-FRC)
W83-03086

TOXICOLOGICAL PROBLEMS ASSOCIATED WITH ALTERNATIVE METHODS OF DISINFECTION,
Health Effects Research Lab., Cincinnati, OH.
R. J. Bull.
Journal of the American Water Works Association, Vol 74, No 12, p 642-648, December, 1982. 7 Tab, 52 Ref.

Descriptors: *Disinfection, *Public health, *Drinking water, *Water treatment, Potable water, Chlorination, Chlorides, Chlorine dioxide, Chlorates, Trihalomethanes, Haloacetonitriles, Carcinogens, Monochloramine, Chlorites, *Toxicity.

Progress that has been made in the last several years in identifying toxicological hazards that are associated with alternate disinfectants themselves or with their reaction products is reviewed. These hazards can be associated with the disinfectants themselves as well as with the products formed when disinfectants such as chlorine, chlorine dioxide, and monochloramine and their by-products chlorite, chlorate, trihalomethanes, and haloacetonitriles are considered. The byproducts of chlorination that have been identified clearly possess carcinogenic properties. Chlorine dioxide possesses antithyroid activity. A substantial by-product of the use of chlorine dioxide, C102, produces hemolytic anemia. Monochloramine possesses mutagenic properties in bacteria and produces changes commonly associated with carcinogens in the livers of mice. Information is at present incomplete on the hazards associated with the formation of toxic byproducts. More work is also needed in the area of formation of byproducts on ingestion of drinking water containing a residual disinfectant. Preliminary studies indicate that byproducts similar to those identified in drinking water are formed in vivo at high doses of disinfectant. How this source of byproducts compares with byproducts formed in water must be examined. Some studies suggest that alteration of the treatment conditions, such as alteration of pH or removal of precursors, may be as important an alternative in treatment as the disinfectant employed. (Baker-FRC)
W83-03087

EFFECT OF ATMOSPHERIC SULFUR POLLUTANTS DERIVED FROM ACID PRECIPITATION ON THE BENTHIC DYNAMICS OF LAKES,
State Univ. of New York, Syracuse. Coll. of Environmental Science and Forestry.
M. J. Mitchell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208322, Price codes: A03 in paper copy, A01 in microfiche. Center for Environmental Research Completion Report, Cornell Univ., Ithaca, N. Y., November 1982. 24 p, 10 Ref, 10 Append. OWRT B-096-NY(1), 14-34-0001-0235.

Descriptors: *Acid precipitation, *Adirondacks, *Benthos, Carbon-bonded sulfur, Chironomidae, Ester sulfate, Hexagenia, Insects, *Lakes, Microcosm, Organic sulfur, Pyrite, Radioisotopes, Secondary production, *Sediment, Sulfate, *Sulfur dynamics, Sulfuric acid, Air pollution, *New York.

Sulfuric acid is a major contributor to acid precipitation in the United States. The relationship of acid precipitation to the sulfur dynamics of three lakes in New York was studied. For South Lake, which has probably been acidified, the sulfur profile in the sediment corresponded to historical changes in anthropogenic sulfur inputs. In all three study lakes, the organic sulfur constituents, which generally have been ignored in limnological investigations, played a major role in sulfur dynamics. The transformations and fluxes of inorganic and organic sulfur differed among the lakes and reflected characteristic abiotic and biotic properties, including productivity parameters. The community structure and secondary production of the invertebrate benthos were ascertained and, for South Lake, were similar to other acidified lakes. The importance of benthic insects on sulfur dynamics was demonstrated. Further studies on sulfur in lakes will enhance the understanding of the role of these anthropogenic inputs on lake systems and permit a more accurate appraisal of the present and future impacts of acidic deposition on water quality.
W83-03093

AN ASSESSMENT OF THE ECONOMIC MAGNITUDE OF ENVIRONMENTAL DAMAGE FROM ACID PRECIPITATION IN THE ADIRONDACKS,
For primary bibliographic entry see Field 6B.
W83-03095

PREDICTION OF THE RESPONSE OF POND BIOTA TO ANIMAL WASTE FERTILIZATION,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
J. H. Peverly, and E. C. Moran.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208835, Price codes: A03 in paper copy, A01 in microfiche. Center for Environmental Research Completion Report, Cornell Univ., Ithaca, N.Y., January 1983. 40 p, 1 Fig, 22 Tab, 38 Ref. OWRT A-087-NY(1), 14-34-0001-9034 and 1134.

Descriptors: Aquaculture, Ponds, *Digested dairy manure, Unionized ammonia, Fish, Aquatic production variability, Phosphorus, Nitrogen, Primary productivity, *Pond fertilization, Water pollution effects.

This study examined the production and water quality response of non-flowing ponds fertilized with anaerobically digested dairy manure at three fertilization rates: 5,500, 16,400, and 36,900 kg ha super -1 yr super -1 (wet weight). Primary productivity, the concentration of solids and fish yield (Micropterus salmoides and Notemigonus crysoleucas) were monitored in addition to N and P concentrations and fluxes. Primary productivity was increased by the manure inputs, to mean levels of 0.8-4.0 g C m super -2 day super -1 in the fertilized ponds versus 0.4-0.6 g C m super -2 day super -1 in the controls. The fish yield, however, was low in this study (0.1-1.1 kg ha super -1 day super -1) as compared to other manure-fertilized systems (5-40 kg ha super -1 day super -1). Microbial biomass supported by the organic substrates in the manure inputs contributed 17% of the total fixed carbon in these experiments. Calculations of N and P flux revealed that P limits production in the unfertilized ponds and in the low-rate ponds

(fertilized at 0 and 0.57 g P m super -2 yr super -1), but not in the moderate and high rate ponds (1.71 and 3.57 g P m super -2 yr super -1). N apparently limits production in these ponds. Both N and P are lost from the water column, but N is lost both more rapidly and more permanently from the pond system. The upper limits on pond fertilization rates are determined by water quality degradation from high ammonia concentrations which can be predicted as a function of manure load; thus, the upper limits on permissible manure inputs can be calculated.
W83-03103

FACTORS CONTROLLING BLUE-GREEN ALGAE DOMINANCE IN A SOUTHWESTERN RESERVOIR,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
D. Toetz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208892, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Oklahoma State Univ., Stillwater, 39 p, 12 Fig, 1 Tab, 22 Ref, 1 Append. OWRT A-106-OKLA(1), 14-34-0001-1138.

Descriptors: *Factor analysis, *Nitrogen fixation, *Nitrogen compounds, *Phosphorus compounds, Physiological ecology, *Phytoplankton, *Principal component analysis, Water quality management, Anabaena, Artifical lakes, Cyanophyta, Light intensity, Nitrogen cycle, Nitrogen, Nitrates, Orthophosphates, Algae, Ammonia, Anacystis, Aphanizomenon, Mathematical analysis, Microcystis, *Oklahoma, Lake Hefner.

Blue-green algae dominate eutrophic impoundments in summer and may contribute nitrogen (N) to the N budget of the lake through nitrogen fixation (NF). The objective of this study was to determine how NF was controlled by the environment and how it was correlated with changes in algal community structure in Lake Hefner, Oklahoma, during the summer of 1981. The contribution of biological nitrogen fixation to the nutrient budget was estimated. Horizontal, vertical, and diel changes in the rate of NF were described and input determined. Nutrient concentrations, light attenuation, chlorophyll a, dissolved oxygen, temperature and pH were measured. The effect of environmental variables on NF was examined through factor analysis. Phytoplankton present in pelagic samples were identified to the lowest possible taxa for information on species presence or absence. Summer, spring and occasional phytoplankton assemblages were identified using factor analysis. Ammonia was inversely related to nitrogen fixation rates. The percentage of heterocysts was high, but absolute densities of nitrogen-fixing algae and heterocysts were low, suggesting these algae were capable of nitrogen fixation but at low rates. Spring and summer phytoplankton assemblages of nuisance algae were identified. The two other assemblages consisted of rarer algae, primarily diatoms.
W83-03109

5D. Waste Treatment Processes

THE SUCCESSES OF INCREASED WASTEWATER TREATMENT PLANT CONSTRUCTION ON THE RHINE (ERFOLGE VERSTARKTEN KLARANLAGENBAUS AM RHEIN),
For primary bibliographic entry see Field 5G.
W83-02802

USE OF EPA'S CAPDET PROGRAM FOR EVALUATION OF WASTEWATER TREATMENT ALTERNATIVES,
Tulane Univ., New Orleans, LA. Dept. of Civil Engineering.
T. J. McGhee, P. Mojgani, and F. Vicidomina.
Journal of the Water Pollution Control Federation, Vol 55, No 1, p 35-43, January, 1983. 6 Fig, 3 Tab, 5 Ref.

Descriptors: *Model studies, *Economic evaluation, *Design criteria, Wastewater treatment, CAPDET model, Computer models, Jefferson Parish, *Louisiana, Alternative planning, Planning.

The CAPDET (Computer Assisted Procedure for the Design and Evaluation of Wastewater Treatment Facilities) program was developed by the U.S. EPA and U.S. Army Corps of Engineers for evaluating wastewater treatment alternatives. This model was applied to 208,000 combinations of flow, location, and effluent standards for the 210 sq km West Bank of Jefferson Parish, Louisiana, where a present population of 168,000 is served by 14 treatment plants of varying capacity and complexity. The top 20 alternatives selected by the model retained the same cost ranking when reanalyzed by more detailed desk top techniques. In this application the flaws of the procedure were: inability to calculate cost for large earthen basins used for aeration or equalization ponds, failure to produce satisfactory comminution and grit removal unit number default values at flows $>$ 2 mgd, 35% underestimation of clarifier and sludge digester sizes, and 50-100% overestimation of annual aeration power costs. Despite these deficiencies CAPDET was considered a useful and economical technique ($1700 for 145 computer runs, excluding manpower). (Cassar-FRC)
W83-02804

TEAM EFFORT SOLVES OPERATIONAL PROBLEMS,
CH2M Hill Southeast, Inc., Gainesville, FL.
G. T. Daigger, G. A. Richter, J. R. Collins, and J. W. Smith.
Journal of the Water Pollution Control Federation, Vol 55, No 1, p 17-22, January, 1983. 6 Fig, 3 Tab, 6 Ref.

Descriptors: *Activated sludge process, *Contact stabilization, *Process control, Wastewater treatment, Memphis, *Tennessee, Aeration, Industrial wastewater, Municipal wastewater, Management, Performance evaluation, Sludge, Operating policies, Design criteria.

The North Memphis Wastewater Treatment Plant, Tennessee, a contact stabilization air activated sludge system, consistently failed to meet secondary treatment standards since beginning operation in August 1977. The plant was designed to treat a municipal wastewater influent of 245 mg per liter BOD, but the actual influent was a soluble, higher strength, readily biodegradable municipal/industrial wastewater with a BOD of 410 mg per liter. Two major problems were identified: insufficient aeration capacity, with poor control of dissolved oxygen concentrations, and inadequate sludge capacity. During an 18 month study operating criteria were developed for meeting treatment standards. These included a 3.5 day mean cell residence time based on the mixed liquor inventory in the contact and stabilization basins, a contact ratio of 1.0 g BOD per g mixed liquor suspended solids per day, a 4-6 hour stabilization basin hydraulic residence time, and total system oxygen requirements of 1.0 g per g BOD. These operating criteria improved plant performance so that the 30 mg per liter total suspended solids and 30 mg per liter BOD standards were violated only twice in 18 months during a period of excessive storm water inflow. A technical review committee, which included representatives from the city and industry, was formed to identify the major problems and potential solutions. An engineering firm was retained to execute the plans under the committee's direction. (Cassar-FRC)
W83-02805

KINETICS OF DISSIMILATORY NITRATE AND NITRITE REDUCTION IN SUSPENDED GROWTH CULTURE,
Rome Univ. (Italy). Dept. of Chemical Engineering.
M. Beccari, R. Passino, R. Ramadori, and V. Tandoi.
Journal of the Water Pollution Control Federation, Vol 55, No 1, p 58-64, January, 1983. 7 Fig, 3 Tab, 15 Ref.

Descriptors: *Kinetics, *Denitrification, *Inhibition, *Wastewater treatment, *Nitrates, *Nitrites, Biomass, Methanol, Chemical reduction, Nitrogen removal, Organic carbon, Nitrous acid, Biological treatment.

Nitrate and nitrite reduction kinetics were studied in suspended growth batch bench-scale tests under strictly controlled conditions. For nitrate reduction: (1) the maximum reduction rate was 0.32 mg nitrate-N per mg volatile suspended solids per day at 25C, pH of 7.5, and biomass concentration of 700-1000 mg volatile suspended solids per liter; (2) the half-saturation constant for methanol as a carbon source was about 30 mg per liter COD, limiting the reduction rate of nitrate with methanol when the concentration of organic carbon was $<$ 40 mg per liter COD; (3) the reaction kinetics were zero-order even at low nitrate concentrations ($<$ 1 mg N per liter) under non-carbon-limiting conditions. For nitrite reduction: (1) the maximum reduction rate was 0.52 mg nitrite-N per mg volatile suspended solids per day at 25C, pH of 7.5, biomass concentration of 500-1100 mg volatile suspended solids per liter, and nonlimiting nitrite concentrations; (2) nitrite concentrations that start inhibition were $<$ 10 mg per liter nitrite-N for low biomass concentrations and increased with biomass concentration; (3) nitrite concentrations slightly above threshold values totally inhibited reduction; (4) inhibition may be a result of the presence of free nitrous acid. Denitrifying biomass was observed to acclimatize to nitrates. However, inhibition was irreversible, making the acclimatized biomass very vulnerable to fluctuations in influent nitrite concentrations. (Cassar-FRC)
W83-02806

MECHANISM OF CLARIFICATION FAILURE,
Olin Chemical Group, Charleston, TN.
V. D. Laquidara, and T. M. Keinath.
Journal of the Water Pollution Control Federation, Vol 55, No 1, p 54-57, January, 1983. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Clarification, *Activated sludge process, *Wastewater treatment, Clarifiers, Design criteria, Process control, Sludge thickening, Settling flux theory.

The settling flux/state point analytical approach (Keinath, et al., 1977) was used to analyze clarification failure function in secondary clarifiers. This theory was confirmed by continuous flow clarifier laboratory experimental results. Clarification failure should occur only when applied flux (Ga) exceeds the maximum flux (Gc). Failure progresses by propagation of a dilute blanket upward from the feed point and the simultaneous increase in feed concentration. Since Gc is always greater than the limiting flux for thickening (GL), the design of secondary clarifiers need not include a clarification failure criterion. Only Class I and II clarification and thickening failure criteria need be considered in the design. This ensures that stray activated sludge flocs are effectively removed. The capacitance against clarification failure can be increased by increasing the depth of submergence of the feed well and the overall clarifier depth. This provides for a greater retention time in the clarification portion of the clarifier and allows increased opportunity for aggregation of biological flocs. (Cassar-FRC)
W83-02807

INVESTIGATIONS ON THE ELIMINATION EFFICIENCY OF METAL HYDROXIDE FLOCS WHICH ARE MADE HYDROPHOBIC BY PRECIPITATION IN THE PRESENCE OF SODIUM STEARATE (UNTERSUCHUNGEN UBER DIE ELIMINATIONSWIRKUNG HYDROPHOBIERTER METALLOXIDHYDRATFLOCKEN),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
R. Wagner, and W. Ruck.
Zeitschrift fuer Wasser und Abwasser Forshung, Vol 14, No 4, p 139-144, August, 1981. 9 Fig, 2 Tab, 11 Ref. English summary.

Descriptors: *Wastewater treatment, *Flocculation, *Sodium compounds, Soaps, Detergents, Separation, Adsorption, Coagulants.

The efficiency of using sodium stearate to enhance the effectiveness of metal hydroxide flocs used as coagulants was investigated. These tests showed that when aqueous solutions containing sodium stearate were treated with aluminum or ferric salts as coagulants, the stearate anions were almost totally eliminated from the solution. Synthetic detergents (anionics (ABS) or nonionics of the polyglycol ether types) were more completely eliminated from solutions containing sodium stearate from solutions not containing sodium stearate. This enhancement of flocculation results from the fact that the metal ions are partially precipitated in the presence of sodium stearate as the corresponding metal soaps. These metal soaps are hydrophobic in character and show a special affinity for sorption of amphiphilic compounds. The study also demonstrated the effect of the type and structure of individual detergents on the sorption process. (Author's abstract)
W83-02812

RESPONSE OF METHANE FERMENTATION SYSTEMS TO INDUSTRIAL TOXICANTS,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
G. F. Parkin, R. E. Speece, C. H. J. Yang, and W. M. Kocher.
Journal of the Water Pollution Control Federation, Vol 55, No 1, p 44-53, January, 1983. 14 Fig, 4 Tab, 16 Ref.

Descriptors: *Anaerobic digestion, *Methane bacteria, *Toxicity, Fermentation, Industrial wastewater, Bacteria, *Wastewater treatment, Nickel, Sulfides, Ammonium, Formaldehyde, Water pollution effects.

The response of methane fermentation systems to industrial toxicants (nickel, ammonium, sulfide, and formaldehyde) was investigated using suspended growth systems and anaerobic filters seeded with acetate enrichment cultures. The extended periods of zero gas production (up to 20 days or 3 times the solids retention time in this study) after application of toxicants did not necessarily indicate destruction of methanogenic viability. Therefore, the system need not be totally cleaned and restarted in all cases of zero gas production. Recovery was accelerated when contamined liquid was removed. A large solids retention time served as a biological safety factor and allowed for acclimatization to the toxicant. Methane bacteria acclimated to all four toxicants. Acclimated bacteria were able to function without reduction in gas production at toxicant levels 2.4-12 times those causing inhibition in unacclimated methanogens. The wastewaters containing toxicants were most effectively treated in reactors with very high solids retention time and relatively low liquid retention time. Examples of these processes include anaerobic filters, anaerobic fluidized beds, anaerobic upflow sludge blankets, and anerobic rotating biological contactors. The threshold doses (concentrations that will result in the onset of decreased gas production) were: < 50 mg per liter for Ni and sulfide, < 100 mg per liter for formaldehyde, and < 2500 mg per liter for ammonia. (Cassar-FRC)
W83-02833

FLOTATION AS THE FINAL CLARIFICATION STEP IN WASTE-WATER TREATMENT AND ITS INFLUENCE ON THE OXYGEN BALANCE OF RECEIVING WATERS,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
K. P. Kiefhaber, U. Neis, and J. Weber.
Water Science and Technology, Vol 14, No 9-11, p 1519-1520, 1982.

Descriptors: *Flotation, *Clarification, *Wastewater treatment, Oxygen balance, Receiving waters, Activated sludge process, Sludge, Dissolved oxygen, Biochemical oxygen demand.

A dissolved-air-flotation (DAF) pilot-scale unit was installed at a conventional municipal wastewater treatment plant with preliminary processes, primary sedimentation, activated sludge and final sedimentation. This municipal treatment plant worked at its design loading during the time of the study. The flotation unit worked in parallel with the sedimentation tank as the final clarification for the activated-sludge mixed liquor. The effluent quality data obtained from these studies were used as input parameters for calculations of the dissolved-oxygen content in streams, using a mathematical model for BOD reduction and reaeration. It was concluded that final clarification of wastewater using flotation improves the dissolved oxygen content of the effluent approximately twofold when compared with sedimentation. Under certain circumstances this effect can lead to avoidance of the dissolved-oxygen sag in receiving waters and promotion of self purification. (Baker-FRC)
W83-02848

THE APPLICATION OF PRETREATMENT PROCEDURES TO LIMIT MEMBRANE FOULING IN REVERSE OSMOSIS RECLAMATION OF SECONDARY SEWAGE EFFLUENTS,
National Inst. for Water Research, Bellville (South Africa). Cape Regional Lab.
H. A. De Villiers, G. R. Botha, and M. W. Wright.
Water Science and Technology, Vol 14, No 9-11, p 1521-1524, 1982. 1 Fig, 1 Tab.

Descriptors: *Reverse osmosis, Effluents, *Wastewater treatment, Reclamation, Water reuse, *Membrane fouling, *Pretreatment, *South Africa.

Early results are presented by the National Institute for Water Research in a new phase of an ongoing program to evaluate the use of reverse osmosis for reclamation of sewage effluents. The objective of the research is to develop a pretreatment process that will reduce the fouling potential of the secondary sewage effluent and will extend the useful life of the reverse osmosis membranes so as to achieve both technical and economic feasibility for this reclamation process. Additional objective included achieving by pretreatment a feedwater with a Plugging Index of less than 60%; restricting the flux decline of the reverse osmosis membranes to less than 20% per annum; and evaluating and developing other criteria whereby the fouling characteristics of the pretreated secondary sewage may be more satisfactorily quantified than by the Plugging Index. The main problem encountered has been the relatively short filter runs of about 12 to 16 hours. This implies a substantial wastage of water for back-washing and also necessitates undue down-time and operator attention. Results achieved thus far in the maintenance of acceptable product water output have been good but inconclusive due to the short operating period for the RO unit. With regular sponge balling and periodic chemical cleaning the flux decline rate has been held at an annual rate of about 15%. (Baker-FRC)
W83-02849

COMPUTER CONTROL IN A BIOLOGICAL SEWAGE PLANT, METHODS AND EXPERIENCE,
Contraga, Inc., Groebenzell (Germany, F.R.).
C. P. Kuznia.
Water Science and Technology, Vol 14, No 9-11, p 1538-1539, 1982.

Descriptors: *Computers, *Biological degradation, *Wastewater treatment, Microprocessors, Munich, Sludge, Activated sludge process, *Federal Republic of Germany.

Results are presented of an 18 month study of microprocessor control in a wastewater treatment plant near Munich, Germany. The city has about 200,000 inhabitants. The oxygen supply subsystem consists of two turbo blowers powered by gas motors and nine Roots blowers driven by electric motors, for a total air flow in the range of 4000 to 4200 cubic meters/h. The sludge from four secondary clarifiers flows into a tank from which the return and the excess sludge is extracted. The control strategy consists in conserving a suitable mass of micro-organisms in the aeration system and maintaining an acceptable mass flow ratio in the aeration basins. Microprocessor technology has now been accepted as a valid tool for process control. The multicom system is described as microcomputer network with decentralized processors for process control, suitable for decentralized plants. The system consists of a central computer in the main control room and two front-end computers out in the plant, one near the aeration tanks and the other in the pump-house. (Baker-FRC)
W83-02851

WATER AND WASTEWATER TREATMENT WITH REUSABLE MAGNETITE PARTICLES,
Commonwealth Scientific and Industrial Research Organization, South Melbourne (Australia). Div. of Chemical Technology.
N. J. Anderson, B. A. Bolto, D. R. Dixon, L. O. Kolarik, and A. J. Priestly.
Water Science and Technology, Vol 14, No 9-11, p 1545-1546, 1982. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Adsorption, *Magnetite process, Colloids, Drinking water, Industrial wastes, Dye industry, Heavy metals, Manganese, Zinc, Copper, Mercury, Cadmium, Algae, Bacteria, Virus.

A technique for the removal of negatively charged colloidal material and some soluble species from a raw water has been developed. The method is based on addition to the water of a pretreated finely sized magnetite slurry, which acts as a coagulent/adsorbent for colloidal material such as clays, humic acids, bacteria, viruses and algae. One of the achievements of the process development was the demonstration that results obtained in jar tests could be reproduced or even bettered in a continuously operating plant. Consequently, application of the process in the field of wastewater treatment is being actively investigated at the jar test level. When applied to a dyehouse effluent the method adsorbed water soluble yellow and red dyes. For paper machines, white water turbidity was reduced and color was reduced without adding to the total dissolved solids. For secondary sewage treatment, phosphate ions were removed and turbidity and color lessened. For heavy metal contaminated water, Mn, Zn, Cu, Hg, and Cd were absorbed. For algae removal the process was efficient over a range of conditions. Bacteria and virus removal was also effective; their concentrations were reduced by a factor of 100 to 10000. (Baker-FRC)
W83-02852

A SYSTEM DEVELOPED FOR THE TREATMENT OF TANNING AND OTHER PROTEINACEOUS EFFLUENTS,
Silverton Tannery Ltd. (South Africa).
S. D Roets.
Water Science and Technology, Vol 14, No 9-11, p 1547-1548, 1982.

Descriptors: *Wastewater treatment, *Proteins, *Tannery wastes, Industrial wastes, *South Africa, Flocculation, Chemical coagulation, Dispersants, Sulfides.

Design criteria were developed for dissolved air flotation, which was found to be the most cost effective method for treatment of tannery effluents in South Africa. In all instances it was necessary to pre-aerate the wastewater for the removal of sulfides, since ferric chloride was used as the primary flocculant. The addition of a manganese salt was needed to act as a catalyst for the complete oxidation of the sulfides. An air saturator was replaced with a continuous foam generator when the system was placed in full scale operation, which would provide a stable foam acting as floc support in order to promote efficient solids removal. The Silflo System was introduced, whereby some of the clear effluent of the flotation unit is recycled for the production of foam. The foam generated as a result of the mixing of air with an acidified effluent contains proteinaceous material. The process is extremely suitable for the treatment of tannery wastewater, but can be extended to treat other types of effluents as well. Results are promising for treatment of wastewater from abattoirs,

chicken processing, general meat processing, paper mills, wetblue plants, fellmongeries and pig slurries. The total solids, sulfide and chromium in tannery waste water can be reduced by more than 98%, while 70% of the COD and BOD is removed as well. (Baker-FRC)
W83-02853

RESEARCH INTO THE MASS CULTURE OF ALGAE IN CLOSED SYSTEMS,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
R. D. Walmsley, S. N. Shillinglaw, and D. Geldenhuys.
Water Science and Technology, Vol 14, No 9-11, p 1569-1570, 1982.

Descriptors: *Algal growth, *Cultures, *Wastewater treatment, Biological degradation, Culture media, Growth media, Culturing techniques, Closed systems, Plastic.

A study was conducted involving a re-evaluation of closed systems, following a consideration of the possible benefits which could be obtained by linking closed algal culture systems with ethanol fermentation units for the production of protein and the treatment of nutrient-rich effluents from fertilizer factories. Studies were made of algal cultures in the laboratory and outdoors in both miniponds and a larger channel-type pond. Cultures of naturally developing algae were grown outdoors semi-continuously on a combination of industrial urea, superphosphate and tapwater. Minipond experiments involving a comparison on the performance of open and closed cultures have established that the enclosure of ponds with transparent plastic stimulates production to a certain extent. Production in the 100 sq m pond during midsummer was extremely low because of the extremely high temperatures which developed. Rotifer infestations were found to be a major problem, and sedimentation of algal cells was excessive. The development of an organic sludge on the channel floors provided an ideal environment for the development of Chironomid larvae, whose emergent adult stages aggregated under the plastic cover, both perpetuating and intensifying the problem. During winter, production in the 100 sq m pond increased above summer values because of the more favorable thermal regime. Enclosure with plastic reduced evaporation rate from greater than 10 mm/day to almost zero. (Baker-FRC)
W83-02854

PHYSICAL-CHEMICAL METHODS OF TREATMENT FOR OIL-CONTAINING EFFLUENTS,
Societe Degremont, Rueil-Malmaison (France).
F. Berne.
Water Science and Technology, Vol 14, No 9-11, p 1995-1207, 1982. 5 Fig, 7 Tab, 4 Ref.

Descriptors: *Oil industry, *Wastewater treatment, *Physiochemical treatment, Industrial wastes, Water pollution sources, Hydrocarbons, Oil spills.

The effluents from pipe-line terminals, de-ballasting units and refineries still contain, after a preliminary oil-removal by gravity in various types of oil-separators, significant residual hydrocarbon concentrations as stable emulsions varying from 25 to 300 mg/liter. It is necessary to submit these effluents to a polishing oil-removal process. Such processes, often called physical-chemical treatment, remove the residual, insoluble hydrocarbons and leave the soluble hydrocarbons only. Practically, depending on the case considered, the final total hydrocarbon content should not exceed from 5 to 20 mg/liter. For this, there are several techniques based on dissolved air flotation or filtration. These processes and their results are summarized. The selection of the appropriate physical-chemical process will be effected either, according to the origin of the effluents, which could give a probable, but not certain, indication as to the anticipated composition of effluents, or preferably from a knowledge of actual data about existing effluents. (Baker-FRC)
W83-02855

PRODUCTION OF ALGAL PROTEIN IN RAW SEWAGE,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 3C.
W83-02856

LOW-COST TECHNOLOGY FOR WATER POLLUTION CONTROL IN DEVELOPING COUNTRIES,
National Inst. for Water Research, Pretoria (South Africa).
G. G. Cillie.
Water Science and Technology, Vol 14, No 9-11, p 1337-1352, 1982. 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Water pollution control, *Developing countries, *Wastewater treatment, *Education, Management, Training, Technology transfer, Water management.

Approximately 80% of all illness in developing countries is related to water in one way or another. The United Nations has begun the International Water Decade. Using low cost technology, the aid planned in this program would cost approximately $100,000 million. Details are given of the design and methods of construction of units which are best suited to the specific requirements and which would be simple, reliable and economical to operate. These can be constructed largely from local materials and by local labor. The need for training of water treatment personnel cannot be overstated. It has often been experienced that an expensive plant and equipment become completely ineffective after only one year of operation due to the neglect of lubrication instructions. On the average more than half of all public water supply schemes in rural and urban fringe areas of developing countries were no longer functioning three years after commissioning. The main danger of any technology being rejected lies in the loss of confidence which may easily occur if a scheme fails soon after implementation. Water treatment plants should preferably be of a nature which enables construction by local unskilled labor. It is stressed that the simplest possible type of equipment compatible with local requirments should be used in each instance, and that the training of the technical personnel and education of the local inhabitants should receive the highest priority. (Baker-FRC)
W83-02858

THE ROLE OF CONSULTANTS,
Vanderbilt Univ., Nashville, TN.
W. W. Eckenfelder, Jr.
Water Science and Technology, Vol 14, No 9-11, p 1279-1280, 1982.

Descriptors: *Planning, *Technology transfer, Wastewater treatment, Wastewater treatment facilities, Design criteria, Management, Decision making, Evaluation.

Two separate cases must be examined in considering the role of consultants in technology transfer: municipal water pollution control and industrial water pollution control. The industrial case would consider industrial wastewater treatment plants or publically owned treatment works with large industrial inputs. It is not seen as feasible to apply results obtained for biological treatment of municipal wastewater to most industrial categories. Technology transfer needs to be restricted to wastewaters of similar chemical composition. With respect to nitrification, the large amount of data presently available permits technology transfer from one situation to another with a high degree of confidence. A new dimension in the water pollution control field recently has been the identification of priority pollutants. Innovative approaches are needed in many areas including source control, and modifications in existing technology such as PAC T, or the addition of powdered activated carbon to the aeration basins and the addition of chemical coagulants to the biological process. The economics of wastewater treatment have drastically changed over the past few years. (Baker-FRC)
W83-02860

SCALE-UP PROBLEMS,
Watson Hawksley, London (England).
J. M. Sidwick.
Water Science and Technology, Vol 14, No 9-11, p 1269-1277, 1982. 19 Ref.

Descriptors: *Planning, *Design criteria, *Wastewater treatment, Wastewater treatment facilities, Pilot plants, Biological treatment.

Consideration is given to some of the problems of the scale-up of wastewater treatment processes from bench scale and from pilot scale to full scale. An attempt is made to put the question of scale-up problems into perspective by reference to the experience of the author and the work of others reported in the literature. Treatments are considered to be classified as chemical, physical and biological in nature. It is concluded from the experiences of the author that the bench-scale work of the research often can not be scaled up with the reliability implied. A bench-scale plant usually needs to be developed into a reasonable pilot scale to simulate the full scale plant, and even then it does not always succeed. Nothing is as good as full scale operation, and often the interpretation of less than full scale work is heavily influenced by full scale operational experience. Finally, the researcher generates the concepts, which may or may not work in practice. The designer and the operator will see whether they work, and will learn much more about the mechanisms of the process thereby. (Baker-FRC)
W83-02861

THEME 4: TECHNOLOGY TRANSFER: REPORT OF THE SESSION CONVENOR,
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.).
S. H. Eberle.
Wate Science and Technology, Vol 14, No 9-11, p 1261-1267 11 Ref.

Descriptors: *Technology transfer, Planning, Water management, Water treatment, Wastewater treatment, Biological wastewater, treatment, Sludge treatment, Activated sludge process.

Aspects discussed under wastewater technology transfer included scale-up problems, the role of participants in the technology transfer process, the need for involvement of practitioners in research and planning, packaging of information in technology transfer programs. Technology transfer was defined as a complex process with proper scale-up or down as the main technical factor and adequate information transfer as well as an end-scaled view in research and development. One very important field in technology transfer is the application of modern technology in the so-called developing countries. Scale-up problems were considered for chemical treatment, physical treatment, biological treatment, and sludge treatment. Consultants play a key role in technology transfer. The function, organization and importance of the equipment supplier is highly variable from one country to another, and it is thus difficult to present a general concept of his role in technology transfer. The need of individual effort on the part of one seeking information is stressed as necessary before any transfer of information can take place. (Baker-FRC)
W83-02872

WATER POLLUTION CONTROL IN DEVELOPING AREAS: PROBLEMS AND NEEDS,
For primary bibliographic entry see Field 5G.
W83-02876

SUPPRESSION OF DENSITY WAVES IN CLARIFIERS,
Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 8B.
W83-02880

THE ROLE OF DOC, UV ABSORPTION AND TOH MEASUREMENTS IN WATER POLLUTION CONTROL,
National Inst. for Water Research, Pretoria (South Africa).
R. A. van Steenderen.

Water Science and Technology, Vol 14, No 9-11, p 1535-1537, 1 Fig, 3 Ref.

Descriptors: *Water pollution control, *Sampling, Water analysis, *Pollutant identification, Measuring, Dissolved oxygen, *Ultraviolet absorption, *Organo-halogen potential, *Organic carbon.

A highly successful unit process which has become an integral part of water purification is that of active carbon adsorption, which serves as a final polishing step to remove color and odors but which above all reduces the amount of organic compounds in the final water. The adsorption capacity of active carbon is not unlimited, and periodic assessments of its condition and effective lifespan are needed. An alternative and less complicated method than determining the life expectancy of the carbon itself is to monitor the quality of the outflow of the carbon column in terms of parameters such as dissolved organic carbon DOC based on wet chemical photooxidation of a sample with infrared detection of the carbon dioxide liberated and total organohalogens TOH based on coulometric titration principles. Pilot plant studies whereby activated sludge plant effluent was passed through columns containing Filtrasorb 300 active carbon illustrated that regular DOC measurements could serve as early indications of carbon column breakthrough. A 12-month quality survey of Pretoria drinking water saw further application of DOC, TOH, and UV measurements, including a relatively new concept called the total organohalogen potential value where samples were overchlorinated and left for 48 hr before analysis. With the exception of TOH, positive inter-correlations existed between DOC, TOH, and UV measurements for a specific water, and the significance of these correlations was dependent on water quality consistency. It was furthermore found that the correlation between DOC and UV values was seasonally dependant. (Baker-FRC)
W83-02882

PARASITES IN SOUTHERN SLUDGES AND DISINFECTION BY STANDARD SLUDGE TREATMENT,
Tulane Univ., New Orleans, LA. School of Public Health and Tropical Medicine.
For primary bibliographic entry see Field 5B.
W83-02887

IMPROVING DESIGN OF A DOMESTIC WASTE DISPOSAL SYSTEM USING AN UNSATURATED FLOW MODEL AND PHOSPHORUS ADSORPTION,
Maine Univ. at Orono. Dept. of Civil Engineering.
W. F. Brutsaert, W. E. Hedstrom, and J. D. McMillan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196527. Land and Water Resources Center Completion Report, Univ. of Maine at Orono, February, 1983. 63 p, 15 Fig, 2 Tab, 43 Ref, 1 Append. OWRT A-50-ME(1), 14-34-0001-9021, -0121, -1121.

Descriptors: *Adsorption, Domestic wastes, Effluents, Groundwater movement, Mathematical models, Model studies, Numerical analysis, *Phosphorus, Septic tanks, Soil water, *Unsaturated flow, Water pollution sources, Path of pollutants, Fate of pollutants, Waste disposal.

A two-dimensional unsaturated flow model including hysteresis was developed to study movement and distribution of domestic septic tank effluent in a mound system. The objective was to improve design by maximizing phosphorus adsorption. Earlier laboratory studies by McNiece (1978) and Foster (1982) indicated that phosphorus adsorption increases substantially with decreasing saturation. Simulation runs of this study, therefore, focused on the maximization of effluent spreading for given mound dimensions, thereby minimizing saturation beneath the trench. Significant results are that hysteresis effects are minor for long-term simulation; that most of the flow (around 75%) and hence most of the P-adsorption in a typical single-trench mound with homogeneous backfill occurs directly below the trench; that the life of a mound with respect to phosphorus adsorption could be extended 2.6 times by dividing the effluent flow between two parallel trenches; and that inserting a soil layer of lower permeability and finer pore size below the single trench could increase the expected phosphorus sorption lifetime 2.1 times.
W83-02900

WASTEWATER STABILIZATION LAGOON EFFLUENT UPGRADING WITH MODIFIED INTERMITTENT SAND FILTERS,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
D. E. Modesitt, and G. W. Shaffer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196642, Price codes: A05 in paper copy, A01 in michrofiche. Missouri Water Resources Research Center Univ. of Missouri, Columbia, November 1982. 86 p, 22 Fig, 15 Tab, 21 Ref. OWRT A-134-MO(1), 14-34-0001-2127.

Descriptors: *Oxidation lagoons, *Sewage lagoons, *Sewage effluents, *Filters(Intermittent sand), *Wastewater treatment, Water pollution control, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen, Phosphorus, Filtration, Field crops(Residue), Harvesting of Algae, Sanitary engineering, Environmental engineering.

Field studies were performed to evaluate the use of intermittent sand filters (ISF) modified with an overlay of corn stalk residue for upgrading wastewater lagoon effluent. An unmodified control filter was also evaluated. Hydraulic loading of 4700 m super 3/ha-d (0.5 mgad) was applied. Influent and effluent measurements were made of BOD sub 5, COD, TKN, TSS, VSS, Total Phosphorous and pH. Data is presented in tabular and graphical form. A modified filter which had a layer of synthetic drainage fabric between the sand and stalks produced a longer filter run before clogging and superior effluent quality than the other modified filter and slightly better or approximately equal performance as compared with the unmodified filter. The following are average influent/effluent values (mg/l) over a ten week period: BOD sub 5 51/15, COD 148/35, TSS 119/6, VSS 97/4, TKN 11/3, total p 2.2/2.6, pH 9.1/7.2. Modified filters restricted the depth of clogging to the top 2.5 cm (1 in) of the sand compared with depths up to 7.6 cm (3 in) in the conventional filter. The overall performance of the modified ISF, while satisfactory was not significantly better than that of the conventional ISF in this study.
W83-02902

COAGULATION AND REMOVAL OF ALGAL SUSPENSIONS FROM WASTEWATER STABILIZATION PONDS,
Missouri Univ.-Columbia. Dept. of Civil Engineering.
J. T. O'Connor, J. T. Novak, and Y. Jalali-Yazdi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196659, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Missouri, Columbia, April 1983. 43 p, 28 Fig, 1 Tab, 8 Ref. OWRT A-135-MO(1), USDI-OWRT-14-34-0001-2127.

Descriptors: *Algae, *Coagulation, *Algal population trends, *Bacterial population trends, Zeta(Electrokinetic) potential, Stabilization ponds, Lagoons, Stabilization ponds, *Wastewater treatment, Zeta meter.

The zeta (electrokinetic) potential of algal surfaces results from interaction of physicochemical properties of the medium with those of algal surface. Thus, the zeta potential of algae depend on the chemical composition of medium and the growth dynamics of the species. Bacterial growth is an intergral part of algal growth. The interwoven population dynamics of the two organisms constitute their symbiosis. Light periodicity induces drastic population fluctuations of algae and bacteria. Comprehensive algal removal methods depend on understanding and manipulation of the relationship between algae and bacteria.
W83-02903

AUTOMATION STUDY OF ACTIVATED SLUDGE PROCESSES,
Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.
N. H. Tang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-202291, Price codes: A04 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Univ. of Puerto Rico, Mayaguez, April 1983. 52 p, 20 Fig, 1 Tab, 13 Ref. OWRT A-062-PR(1), 14-34-0001-1141.

Descriptors: *Activated sludge, *Control systems, Domestic wastes, *Automation, *Wastewater treatment.

This study is divided into the following parts: (1) a summary of the existing control strategies, (2) an evaluation of the control strategy selected for detailed analysis, and (3) the development of a fully automatic control system for the activated sludge biological treatment process. The use of the solids flux curve for the dynamic-state control of a completely mixed activated sludge process has been analyzed in detail. From the analyses carried out, the following conclusions can be drawn: (1) the new approach for dynamic-state control of activated sludge processes is both practically feasible and theoretically sound, (2) for practical purposes, constant C sub o for the control equation can be considered a good approximation, (3) the solids flux curve needs to be renewed periodically, (4) a technique is offered for minimizing the loss of sludge into the effluent under extraordinary surge flow conditions, (5) the integration of this control approach into plant automation has a very promising future.
W83-02909

LABORATORY STUDY OF DYNAMIC-STATE CONTROL OF ACTIVATED SLUDGE PROCESSES,
Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.
N. H. Tang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-202309, Price codes: A03 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Univ. of Puerto Rico, Mayaguez, April 1983. 41 p, 17 Fig, 7 Tab, 5 Ref. OWRT A-066-PR(1), 14-34-0001-1141.

Descriptors: *Activated sludge, *Control systems, Domestic wastes, *Wastewater treatment, *Sludge treatment.

A laboratory study on using the solids flux curve for the dynamic-state control of a completely mixed activated sludge process was carried out. Activated sludge of a municipal sewage treatment plant was transported to the laboratory. First, the g and h values of the sludge settling characteristics were determined; then using these values together with the values of the sludge suspended solids concentration and the surface area of the settling tank, a sludge recycle rate was calculated for a given influent flow rate. The laboratory activated sludge treatment unit was operated with various influent flow rates and their respective calculated sludge recycle flow rates. Several conclusions have been drawn from this laboratory study. Firstly, the concentration profile in the settling column demonstrates again the typical profile exhibited during the period when the clarifier-thickener is operated at the fully-loaded condition. Secondly, the solids distribution between the aeration tank and the settling tank should remain at stable condition if the thickener is operated at the fully-loaded condition. Lastly, the new control approach should be tested at a small sewage treatment plant.
W83-02910

VOLATILIZATION OF ORGANIC TRACE CONTAMINANTS BY AIR STRIPPING FOR WATER RECLAMATION,
Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, G. D. Hopkins, C. Munz, and A. H. Riojas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-202374,

Price codes: A06 in paper copy, A01 in microfiche. Office of Water Research and Technology Report OWRT/RU-82/11, U.S. Dept. of the Interior, Washington, D.C., December 1982. 106 p, 41 Fig, 13 Tab, 73 Ref, 10 Append. OWRT C-90235-R(No. 0474)(1), 14-34-0001-0474(1).

Descriptors: *Wastewater treatment, *Water treatment, *Organic compounds, *Aeration, *Chlorinated hydrocarbons, *Mass transfer, Air stripping, Trace organics.

This research was undertaken to assess the validity of the chemical engineering unit operations approach for characterizing the performance of countercurrent air stripping in a packed column as a means of separating volatile organic solutes from aqueous solution. The experiments were conducted in a small packed column under laboratory conditions controlled to assure a stringent test of the unit operations models. Mass transfer models frequently applied in the chemical engineering literature were tested, using as a criterion the ability to simulate and to predict organic solute removal in a laboratory packed column. Mass transfer models based on semi-empirical correlations that account for the resistances in both the liquid and gas phases were found to predict adequately the observed column performance. Indeed, good agreement between prediction and experiment was found even under conditions outside the range in which the mass transfer correlations previously had been validated. Only in extreme cases where the stripping factor was less than unity did the agreement between theory and observation deteriorate, and such exceptional cases are not of practical interest for treatment applications. Based on this work, it is justified to use the customary chemical engineering approach for design of countercurrent, packed-column air strippers for water reclamation.
W83-02917

A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE DYNAMICS OF BREAKPOINT CHLORINATION IN DISPERSED FLOW REACTORS,
California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 5F.
W83-02926

NITRIFICATION PROCESS IN A PACKED BED REACTOR WITH A CHEMICALLY ACTIVE BED,
Polish Academy of Sciences, Zabrze. Inst. of Environmental Engineering.
E. Kowalski, and Z. Lewandowski.
Water Research, Vol 17, No 2, p 157-160, February, 1983. 3 Fig, 8 Ref.

Descriptors: *Calcium carbonate, *Nitrification, *Neutralization, *Wastewater treatment, Marble, Hydrogen ion concentration, Alkalinity, Oxidation, Ammonium, Nitrates.

Crushed marble used as a packing material in a wastewater nitrification reactor neutralized the hydrogen ions formed by bacterial metabolism, maintaining the effluent pH of 6-8 for about 160 days, compared with about 50 days for an inert gravel bed. No other alkalinity control was necessary. The 170 mg per liter ammonium-N influent was oxidized in one step with 95% efficiency for 180 days, after which the pH dropped to less than 4 and efficiency started to decrease. (Cassar-FRC)
W83-02947

RATE CONSTANTS OF REACTIONS OF OZONE WITH ORGANIC AND INORGANIC COMPOUNDS IN WATER--I. NON-DISSOCIATING ORGANIC COMPOUNDS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5F.
W83-02950

RATE CONSTANTS OF REACTIONS OF OZONE WITH ORGANIC AND INORGANIC COMPOUNDS IN WATER--II. DISSOCIATING ORGANIC COMPOUNDS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5F.
W83-02951

A KINETIC MODEL OF STEADY STATE PHOSPHORUS FIXATION IN A BATCH REACTOR--IV,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. R. Overman, R. L. Chu, and B. R. McMahon.
Water Research, Vol 17, No 1, p 15-19, January, 1983. 7 Fig, 1 Tab, 6 Ref.

Descriptors: *Kinetics, *Phosphorus, *Wastewater treatment, Model studies, Adsorption, Batch reactors.

A kinetic model was developed to describe phosphorus fixation in a batch wastewater treatment reactor. It included adsorption, transformation, decomposition, and reaction. The model described steady state fixation and the dependence of the maximum rate of fixation and of the rate factor on soil mass/solution volume ratio. Sites for adsorption and transformation behaved in a catalytic manner, either by regeneration of sites or by generation of new sites. About 99% of the transformed phosphate was apparently unstable. The remaining 1% was probably either an essentially insoluble colloidal aluminum phosphate or iron phosphate. (Cassar-FRC)
W83-02952

THEORETICAL AND EXPERIMENTAL STUDY OF FACTORS AFFECTING CAPILLARY SUCTION TIME (CST),
Tokyo Inst. of Tech. (Japan). Dept. of Environmental Chemistry and Engineering.
H. Unno, H. Muraiso, and T. Akehata.
Water Research, Vol 17, No 2, p 149-156, February, 1983. 10 Fig, 5 Ref.

Descriptors: *Sludge filters, *Filter rate, *Capillary suction time, Dewatering, *Wastewater treatment, Sewage sludge, Filtration.

Factors affecting capillary suction time in sewage sludge were studied in theory and by experiment. A device for measuring linear capillary suction time (LCST), simpler than conventional radial equipment, was developed. The LCST was correlated with the specific resistance to filtration of sludge when the product of specific resistance and cake mass deposited per unit volume was greater than a critical value. Below these critical values, the LCST was not well correlated with filterability, but correlated with solid concentration of the suspension. (Cassar-FRC)
W83-02955

EDTA AS A KINETIC INHIBITOR OF COPPER(II) SULFIDE PRECIPITATION,
Maryland Univ., College Park. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W83-02956

EXPOSURE TO MICROBIAL AEROSOLS FROM ACTIVATED SLUDGE TREATMENT,
Hawaii Univ., Honolulu. Water Resources Research Center.
A. W. Lam, and H. F. Young.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208579, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 145, November 1982. 63 p, 12 Fig, 20 Tab, 41 Ref. OWRT A-088-HI(1), 14-34-0001-1113.

Descriptors: *Bioindicators, *Public health, Wastewater treatment, Path of pollutants, *Hawaii, Activated sludge process, Pathogens, Pollutant identification, Coliforms, *Microbial aerosols, Wahiawa sewage treatment plant, Pearl City Wastewater Treatment Plants.

Viable pathogens are generally present at every stage of wastewater treatment. Thus a potential airborne infectious pathway due to microbial aerosols exists, particularly at activated sludge treatment plants. In this study the concentration of sewage borne indicator bacteria and viruses in effluent aerosols was determined and the exposure to such aerosols by treatment plant workers was estimated. Initial aerosols collection with fog-gage screen collectors yielded erratic results due especially to lack of control over sampled air volume and slit openings too large for effective collection. Standard Andersen and glass impinger collectors were used throughout the field study. Areas downwind of aeration basins yielded as much as 1 657 CFU/m super 3 total bacteria and 1.8 PFU/m super 3 coliphage. These aerosols were mostly 2.1 to 3.3 um droplet nuclei with a high potential for inhalation and bronchial retention. The inhalation of microbial aerosols by Wahiawa treatment plant workers was estimated to be between 48 to 94 total bacteria/person/day above background levels. The inhaled total coliform level may average 8 to 27 CFU/person/day. This usually short duration and sometimes intense exposure could not be implicated directly to cause adverse health effects. Correlations of statistical tabulations of sick-leave illness with degree of exposure were not significant at the 0.01 or the 0.05 level.
W83-03097

SOLAR HEATING OF WASTEWATER STABILIZATION PONDS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
S. L. Klemetson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208603, Price codes: A05 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report No 121, Colorado State University, Fort Collins, March 1983. 91 p, 29 Fig, 5 Tab, 35 Ref, 2 Append. OWRT A-046-COLO(2), 14-34-0001-9006 and 0106.

Descriptors: *Stabilization ponds, *Wastwater treatment, *Wastewater disposal, *Solar heating, Heated water, Water temperature, Model studies, Computer models, Dissolved oxygen, Biochemical oxygen demand.

Performance of wastewater stabilization ponds or sewage treatment lagoons is dependent upon pond water temperature. In recent years there has been considerable interest expressed in raising pond water temperatures in an effort to improve performance of the treatment process. Solar heat may be one energy source useful in raising pond water temperatures. In this study the experimental models were designed using a computer model to assess the effect of adding solar heat to waste stabilization ponds. Six model ponds were constructed and sewage water temperatures in both heated and unheated control systems were analyzed. The experimental ponds showed an average temperature increase of 4.7C (8.5 F) over that of the unheated control pond during the test period using a solar collector effective area equal to pond surface area. Pond surfaces were kept ice-free during the daylight hours. By adding heat at the bottom of the ponds it was possible to increase temperatures and dissolved oxygen levels throughout the depth of the ponds.
W83-03100

EFFECT OF OZONATION ON THE BIODEGRADABILITY AND ADSORBABILITY OF SPECIFIC ORGANICS TO BE REMOVED IN THE 'BIOLOGICALLY ACTIVATED CARBON (BAC)' PROCESS,
Massachusetts Univ., Amherst. Water Resources Research Center.
F. A. DiGiano, S. F. McShane, and M. F. Lorenzo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208876, Price codes: A06 in paper copy, A01 in microfiche. Publication No 135, December 1982. 109 p, 31 Fig, 17 Tab, 34 Ref, 1 Append. OWRT A-132-MASS(1), 14-34-0001-0123.

Descriptors: *Wastewater treatment, *Ozonation, *Activated carbon, *Biological treatment, *Organic carbon, *Organic compounds, *Biodegradation, Advanced wastewater treatment, Activated sludge process, Oxygen uptake, Biological oxidation, Biochemical tests, Substrates, Sorption, Adsorption, Acids, Phenols, Isotherms.

Phenol, 2,4 dinitrophenol, paranitrophenol, benzoic acid and ortho-, meta- and parachlorobenzoic acid were ozonated and changes in the adsorption isotherm were measured. Gilson respirometry studies were conducted using unozonated solutions of phenol and benzoic acid in order to measure the availability of sorbed substrate for biodegradation. Similar studies with ozonated solutions examined the effect of ozonation on the biodegradability and availability of sorbed substrate. Even at low ozone dosages, the adsorption isotherm, as measured by the total organic carbon of the mixture, was in most cases different than that of the parent compound; adsorption was decreased but there were also exceptions. Competitive adsorption between the residual parent sorbate and the low concentration(s) of by-products of ozonation was suggested but not proven. Sorbed substrate was shown to be available for biodegradation. Ozonation of phenol increased oxygen uptake substantially in flasks containing activated carbon, but not in flasks containing sand. In the absence of sorbed substrate, ozonation may not necessarily lead to increased oxygen uptake if the effect of ozonation is to lower the stoichiometric amount of oxygen required for biodegradation.
W83-03107

THE EFFECT OF AERATION BASIN CONFIGURATION ON ACTIVATED SLUDGE BULKING AT LOW ORGANIC LOADING,
California Univ., Berkeley. Sanitary Engineering Research Lab.
S. -E. Lee, B. L. Koopman, D. Jenkins, and R. F. Lewis.
Water Science and Technology, Vol 14, No 6/7, p 407-427, 1982. 12 Fig, 4 Tab, 23 Ref.

Descriptors: *Activated sludge process, *Bulking sludge, *Aeration basins, Organic loading, Sludge thickening, Anaerobic conditions, *Wastewater treatment, Richmond, *California, Laboratory studies.

Continuous flow laboratory scale activated sludge units were operated using domestic sewage from Richmond, California, at low ratios of food to microorganisms (F/M). In the F/M range of 0.05-0.25 g COD removed per g total mixed liquor volatile suspended solids (TMLVSS)-day, bulking did not occur with a low BOD (139 mg per liter) sewage feed and TMLSS of 1.5 g per liter. Addition of raw sludge (total BOD of the mixture, 315 mg per liter) increased the TMLSS to 3.5 g per liter. Bulking occurred in the 2, 4, 8, and 16 compartment units. An aeration basin with an initial compartment 1/32 of the aeration basin volume prevented, but did not cure, bulking. An aeration basin with initial compartments 1/74 of aeration basin volume prevented and cured bulking. Anoxia in an aeration basin with 2 initial compartments each 1/64 of the total volume did not cure bulking. The sludge volume index of sludges produced at low F/M and high TMLSS were dependent on conditions in the initial compartment rather than those in the remainder of the aeration basin. Soluble COD, F/M, and the size of the first compartment were important factors controlling bulking; floc loading, dispersion number, and total number of aeration basin compartments were not important. (Cassar-FRC)
W83-03120

AEROBIC THERMOPHILIC STABILIZATION OF SLUDGE VERSUS ANAEROBIC DIGESTION AND OTHER KINDS OF SLUDGE TREATMENT AT MIDDLE-SIZED PLANTS WITH RESPECT TO POWER CONSERVATION AND ECONOMY,
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
P. Wolf.
Water Science and Technology, Vol 14, No 6/7, p 727-738, 1982. 8 Fig, 6 Tab, 5 Ref.

Descriptors: *Sludge handling, *Wastewater treatment, *Cost analysis, Financial aspects, Sludge digestion, Anaerobic digestion, Conservation, *Federal Republic of Germany.

Operating data concerning energy balances were collected by a state bureau from a sewage treatment plant with aerobic-thermophilic stabilization and also from plants with anaerobic sludge digestion and energy recovery. On the basis of these data, power and heat balances as well as cost-benefit calculations have been obtained for treatment plants of different sizes with different biological and sludge treatment processes. In spite of high and rising energy costs in plants using the aerobic-thermophilic stabilization process, the results show an overall economic benefit for this process at small and middle sized treatment plants compared to those using anaerobic sludge digestion. The evaluation of data indicates that this economic benefit is due to high capital costs and low efficiency of energy recovery under process conditions at small and middle-sized plants applying anaerobic digestion. (Baker-FRC)
W83-03121

THE PERFORMANCE OF AN ULTRAFILTRATION PILOT-PLANT FOR THE CLOSED LOOP RECYCLING OF TEXTILE DESIZING EFFLUENTS,
Natal Univ., Durban (South Africa).
C. A. Buckley, R. B. Townsend, and G. R. Groves.
Water Science and Technology, Vol 14, No 6/7, p 705-713, 1982. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Recycling, *Textiles, Textile mill wastes, Industrial wastewater, Filtration, Ultrafiltration, Closed loop recycling.

The results of sixteen months' operation of an ultrafiltration pilot plant for the closed loop treatment and recylcing of textile desizing effluent containing polyvinyl alcohol are described. Operation in the batch concentration and continuous modes is compared. Data on the effects of feed temperature, reject flow rate, size concentration and membrane cleaning on the permeate production rate are presented. The environmental impact and economics of a full-scale plant are discussed. Trials have demonstrated that excellent results can be obtained from the closed loop treatment and recycle of desizing effluents containing PVA size. Ultrafiltration membrane performance was consistent, and adequate cleaning techniques were developed to prolong membrane lifetime. It is estimated that the installation of the closed loop recycle system will reduce the water consumption of the textile mill by 19,000 cubic meters per year and reduce the annual chemical oxidation demand pollution load by 900 tons. (Baker-FRC)
W83-03123

AN INTEGRATED LOW COST SYSTEM FOR TREATMENT OF POTATO PROCESSING WASTERWATER INCORPORATING ANAEROBIC FERMENTATION AND PHOSPHORUS REMOVAL,
Water Science Labs. Pty Ltd., Melbourne (Australia).
J. G. Parker, B. J. Lyons, and C. D. Parker.
Water Science and Technology, Vol 14, No 6/7, p 675-687, 1982. 4 Fig, 7 Tab, 10 Ref.

Descriptors: *Wastewater treatment, *Food-processing wastes, *Fermentation, Methane, *Anaerobic conditions, *Phosphorus removal, Phosphorus, Sludge disposal, Fertilizers, Land disposal, Industrial wastes.

The pollution load from a modern potato processing plant represents a substantial wastewater treatment and disposal problem with considerable potential for process innovation. A low-cost area integrated system for treatment of all process wastewaters, incorporating treatment of high strength wastes by anaerobic fermentation and phosphorus removal facilities, has been developed from pilot plant studies. This plant offers considerable potential for application to treatment of other food processing wastes. The system incorporated anaerobic methane fermentation phosphorus removal processes. Operating data have indicated consistent achievement of an overall BOD5 removal efficiency of 90% and an overall phosphorus removal efficiency of 93%. Total annual treatment cost is about $0.15/kg BOD5 removed. The anaerobic fermentation process has major cost advantages over conventional processes for treatment of high organic strength industrial wastes with minimal land area requirement and low energy requirement. Disposal of residual phosphorus sludge to land has demonstrated the excellent fertilizer value of this sludge and the prudent use of a valuable agricultural resource. (Baker-FRC)
W83-03124

SIMULTANEOUS PASTEURIZATION - DIGESTION (SPD-PROCESS),
Niersverband, Viersen (Germany, F.R.).
G. Kugel.
Water Science and Technology, Vol 14, No 6/7, p 739-748, 1982. 4 Fig, 21 Ref.

Descriptors: *Sludge digestion, *Wastewater treatment, Sludge, Pasteurization, Digestion, Thermophilic digestion, Organic matter, Degradation, Niers River basin, Federal Republic of Germany.

As part of the regional sludge disposal system of recycling to land, which is integrated into the Niers river basin management of the Niersverband, F pasteurization is done in combination with the anaerobic stabilization of sludge in order to ensure long term agricultural disposal in agreement with hygienic standards, which is in general much less expensive than any other alternative for sludge handling and disposal. During the past 15 years of Niersverband activity in liquid sludge recycling, pasteurization has been done after digestion. This pasteurization step has now been successfully placed before the anaerobic stabilization step, with sufficient gas yield, organic matter degradation and stable low concentration of organic acids in the digester at a positive gas energy balance. Further optimization has reduced energy loss consumption, especially at the recooling stage. At larger sewage treatment plants coupling of the spd-process with electric energy generation by a gas engine or gas turbine seems to be of high interest because the hot flue gas from that side can be used at low pressure for submerged combustion heating of sludge. The spd-process could also be favorable for thermophilic digestion or for step digestion at a thermophilic and a following mesophilic stage. Thus a further impetus for development of anaerobic stabilization may be expected in the near future. (Baker-FRC)
W83-03125

INHIBITION MODELING IN ANAEROBIC DIGESTION,
Aveiro Univ. (Portugal).
A. C. Duarte, and G. K. Anderson.
Water Science and Technology, Vol 14, No 6/7, p 749-763, 1982. 11 Fig, 5 Tab, 14 Ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Inhibition, Mathematical studies, Mathematical equations, Propionic acid.

The effects of volatile acids and pH on anaerobic digestion were studied in laboratory and pilot-scale digesters. The wall growth was shown to be an important parameter when operating digesters at low solid concentrations. Inhibition of the anaerobic digestion process was noted at pH values below 6.3 or at unionized volatile acid concentrations of 10 to 25 mg/l as acetic acid. Wall growth plays an important role during the operation of laboratory scale digesters at low solids concentration. Propionic acid utilization can become the rate limiting step in anaerobic digestion of soluble wastes for certain specific conditions. The usual pH changes during digester operation require the use of sophisticated models, even to predict the steady state. At constant pH, however, the Monod model should suffice. The effects of pH and volatile acids can be satisfactorily described by available models of anaerobic digestion. (Baker-FRC)
W83-03126

ELEMENTS OF THE INHIBITION OF NITRIFYING BACTERIA,
Rennes-1 Univ. (France). Lab. of the Chemistry of Water and the Environment.
G. Martin, and Y. Richard.
Water Science and Technology, Vol 14, No 6/7, p 781-794, 1982. 11 Fig, 4 Tab, 14 Ref.

Descriptors: *Nitrification, *Bacteria, *Wastewater treatment, *Inhibition, Organic compounds, Metals, Heavy Metal, Toxicity, Minerals, Nitrates, Oxidation, Ammonia.

Laboratory experiments were conducted on ammonia bio-oxidation to nitrates by mixed culture of nitrifiers in order to quantify the influence of mineral and organic pollutants on biokinetics parameters. The inhibitory effects of various heavy metal ions were studied using laboratory scale activated sludge and submerged filter units. Depending on the unit process and the metal involved, inhibitory effects are observed at concentrations above 1 mg/1. Results obtained provide further support for an hypothesis suggested as an explanation of the toxicity of compounds such as heavy metals. This theory is based on a Freundlich adsorption law of heavy metals on nitrifying sludge. No change in inhibitory effects is obtained using fixed films in submerged filters. The effects of organic compounds were examined using the same laboratory procedure. Inhibitory effects of organic compounds in submerged filters depend on their absorptive property. Each of the organic compounds involved may effect nitrifying bacteria. (Baker-FRC)
W83-03127

GRANULAR ACTIVATED CARBON AND PREOZONATED GRANULAR ACTIVATED CARBON TREATMENT FOR BIOLOGICALLY AND PHYSICALLY-CHEMICALLY TREATED WASTEWATER EFFLUENTS,
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
A. Netzer, and J. L. McNutt.
Water Science and Technology, Vol 14, No 6/7, p 619-627, 1982. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Activated carbon, *Ozonation, Pretreatment, Municipal wastewater, Industrial wastes, Ozone, Disinfection, Hydrogen sulfide, Texas, Garland.

Problems in the operation and implementation of granular activated carbon systems for the combined biological and physical-chemical treatment of effluents at the Duck Creek Wastewater Treatment Plant prompted the design and construction of a pilot plant facility composed of 5 pilot plant systems. This facility provides for evaluation of simultaneous granular activated carbon treatment and preozonated granular activated carbon treatment for biologically, physically-chemically, and blended treated wastewater effluents. The pilot plant facility has been in operation since November 1979, demonstrating the improved operation and treatment efficiency of preozonated granular activated carbon treatment for these effluents. The study has shown that the preozonated granular activated carbon treatment systems provided superior treatment efficiencies in almost all parameters compared to the granular activated carbon treatment systems treating the same wastewater effluents. While the average period of operation for the granular activated carbon treatment systems before exdhaustion was 70 days, the preozonated granular activated carbon treatment systems operated nearly 300 days without exhaustion. Production of hydrogen sulfide was non-existent in the preozonated granular activated carbon system. The pressur- of this gas was evident in the area of the nonpreozonated granular activated carbon systems. (Baker-FRC)
W83-03128

AN IN SITU COMPARISON OF THE EFFECTIVENESS OF FOUR ALGICIDES,
Ott Water Engineers, Inc., Anchorage, AK.
R. W. Hoffman, G. Bills, and J. Rae.
Water Resources Bulletin, Vol 18, No 6, p 921-927, December, 1982. 4 Fig, 2 Tab, 36 Ref.

Descriptors: *Algicides, *Alkaline water, *Equalizing basins, Ponds, *Wastewater treatment, Herbicides, Simazine, Diuron, Copper citrate, Copper ethanolamine, Bioassays, Chelation, Stabilization ponds, Wastewater lagoons, Industrial wastewater, *Colorado.

The effectiveness of four algicides was evaluated by in situ bioassays in a wastewater equalization pond at the R. D. Nixon Power Generating Station, Colorado Springs, Colorado, during August-September 1980. This water had pH of 9.2, total dissolved solids of 610 mg per liter and high nutrient concentrations. The order of effectiveness of the chemicals was simazine > diuron > copper ethanolamine > copper citrate. Tests were conducted in clear 60-liter plastic bags suspended in the ponds. Three concentrations (on the order of 0.05-3.0 ppm) of each chemical were tested. Additions were made on August 26 and again on September 11. Effectiveness was measured in terms of chlorophyll a, productivity, and algal counts. Although simazine was rated more effective than diuron, the concentrations tested in this study were not equivalent, 0.5-3.0 ppm simazine and 0.05-1.0 ppm diuron. The copper algicides were not as effective in this alkaline water because free copper is not freely available in the pH range of the pond water. (Cassar-FRC)
W83-03137

5E. Ultimate Disposal Of Wastes

THERMAL PRETREATMENT OF SLUDGES--A FIELD DEMONSTRATION,
R. T. Haug, T. J. LeBrun, and L. D. Tortorici.
Journal of the Water Pollution Control Federation, Vol 55, No 1, p 23-24, January, 1983. 3 Fig, 3 Tab, 10 Ref.

Descriptors: *Sludge digestion, *Anaerobic digestion, *Heat treatment, Sludge thickening, Sludge conditioning, Digestion, Pretreatment of sludge, Dewatering, Pathogens, Bacteria, Energy, Odor control, Thermophilic digestion.

The concept of thermal pretreatment of primary and waste activated sludges followed by anaerobic digestion was demonstrated in a pilot-scale facility over a 16 month period. The apparatus consisted of a trailer-mounted thermal conditioning system, a 45.4 cu m complete mix digester, and several dewatering devices to evaluate the effectiveness of the conditioning/digestion. Thermal pretreatment at a temperature of 171 to 218C did not significantly affect digester performance. Compared with conventional thermal conditioning, the thermal pretreatment/anaerobic digestion system produced less degradable COD recycle to the wastewater treatment plant, produced a favorable energy balance, improved odor control in dewatered cake solids and liquor sidestreams, reduced the amount of solid for final disposal, and completely destroyed pathogens. (Cassar-FRC)
W83-02831

MORTALITY PATTERNS OF INDICATOR ORGANISMS DURING AEROBIC DIGESTION,
Black and Veatch, Denver, CO.
R. D. Kuchenrither, and L. D. Benefield.
Journal of the Water Pollution Control Federation, Vol 55, No 1, p 76-80, January, 1983. 3 Fig, 4 Tab, 10 Ref.

Descriptors: *Bacteria, *Sludge digestion, *Aerobic digestion, Fate of pollutants, Indicators, Digestion, Pathogens, Streptococcus, Staphylococcus, Coliforms, Land application, Temperature effects.

The fate of indicator organisms during aerobic digestion at temperatures in the upper mesophilic range was investigated. Fecal coliforms, streptococci, and staphylococci concentrations were determined through the aerobic digestion process at 20, 30, and 40C, at 5, 8, 12, 15, 25, and 35 days. In general, fecal coliforms and fecal streptococci concentrations decreased with time; the rate of decrease was higher at higher temperatures. The times required to reach the digested sludge stage (destruction of bacteria) were: fecal coliforms, 15 days at 20C, 8 days at 30C, and zero at 40C; fecal streptococci, 15 days at 20C, 10 days at 30C, and 7 days at 40C. Data for staphylococci were less easy to analyze numerically. The organisms appeared to adapt to the 20 and 30C temperatures and subsequently propagate. These effects were less pronounced as temperatures increased. At 40C, adaptation, but not progagation, took place; numbers were not materially reduced after 35 days digestion. (Cassar-FRC)
W83-02834

THE ENUMERATION OF STREPTOCOCCI AND MYCOBACTERIA PRESENT IN LANDFILL LEACHATE,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W83-02885

THE SURVIVAL OF BACTERIAL INDICATORS IN LYSIMETERS AND LANDFILLS,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
J. A. Donnelly, P. V. Scarpino, and D. Brunner.
Water Science and Technology, Vol 14, No 9-11, p 1558-1559, 1982.

Descriptors: *Landfills, *Bacteria, *Leachates, Waste dumps, Municipal waste, Bacteria, Enterobacter, *Fate of pollutants, Moisture content.

The presence of pathogenic bacteria and pathogenic bacterial indicators was determined in leachate and solid waste from two 2-year-old lysimeters, one of which contained municipal solid waste and the other hospital waste, and also from a full scale landfill containing municipal solid waste that was 9 years old. The solid waste and leachate within lysimeter D, exposed after 2 years, was examined at three descending levels. The total coliforms, fecal coliforms, fecal coliforms, and fecal streptococci were all present in the top solid waste level at concentrations of 1300, 90, and 71,000 MPN/100 g, respectively. At the upper levels (5 feet) within the solid waste of the Boone County landfill the fecal indicators decreased, and then increased to significant concentrations at 8.5 to 10.5 feet. The total coliform, fecal coliform, and fecal streptococci concentrations were 35,000, 400, and 35,000 MPN/100 g of solid waste. The leachate within the landfill also demonstrated high bacterial concentrations and contained total coliform, fecal coliform, and fecal streptococci levels of 9,200, 350, and 110 MPN/100 ml. Also at the landfill several types of gram-negative rods were isolated. It was concluded that the landfill conditions differ significantly from the surrounding soil, as determined by the presence of large numbers of fecal indicator bacteria, high conductivity, and a high percentage of moisture. It is this latter quality of the waste that has probably been important in maintaining the long microbial survival in the landfill. (Baker-FRC)
W83-02886

IMPROVING DESIGN OF A DOMESTIC WASTE DISPOSAL SYSTEM USING AN UNSATURATED FLOW MODEL AND PHOSPHORUS ADSORPTION,
Maine Univ. at Orono. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W83-02900

WASTE FROM THE WATER TREATMENT PLANT AT ALTON AND ITS IMPACT ON THE MISSISSIPPI RIVER,
Illinois State Water Survey Div., Champaign.
R. Evans, T. Hill, D. Schnepper, and D. Hullinger.
ISWS Circular 156, 1982. 62 p, 16 Fig, 13 Tab, 12 Ref.

Descriptors: *Water treatment, *Water treatment facilities, *Solid wastes, *Bottom sediments, Rivers, Clarification, Aluminum, Iron, Aquatic life, Silt, Sand, Wastewater outfall, Chemical wastes, Macroinvertebrates, Sludge solids, Bottom sampling, *Illinois, Mississippi River, Alton.

Treating Illinois' public water supplies produces a quantity of wastes, which are mostly solids in the suspended and dissolved form at concentrations higher than the raw water being treated. The two principal sources of waste from the treatment plants are basin sludge and from backwash operations. This study attempted to determine the quantity and characteristics of wastes produced in a moderate-sized treatment plant employing the clarification process, and to assess any effects of the discharge on a large river. The Alton plant generates about 12,500 pounds of waste solids per day. The major chemical constituents are iron and aluminum. Except during 7-day, 10-year low flow conditions, increases in suspended solids in the Mississippi River during occurrences of maximum waste discharges will not be perceptible. Wastes are detectable in bottom sediments by increases in iron, aluminum, moisture, and volatile content, but only about 200 feet offshore and within 2000 feet downstream of the waste outfall. The composition of sand-silt-clay relationships also changed within the impacted area, with a higher ratio of silt and a lower ratio of sand. However, there was no measurable blanket of sludge deposits. Without these deposits and with no evidence that the iron and aluminum concentrations are toxic to aquatic organisms, sediment changes in the impacted area do not indicate environmental degradation. All sampling stations were classified as polluted or semi-polluted. Near-shore sediments, including those in the impacted area, supported a higher density and diversity of macroinvertebrates than any of the other locations, due to the silty-sand bottom sediments. (Atkins-Omniplan)
W83-02920

NUMERICAL SIMULATION OF FLOW AND CONTAMINANT MIGRATION AT AN EXTENSIVELY MONITORED LANDFILL,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W83-02942

GEOLOGIC AND WELL-CONSTRUCTION DATA FOR THE H-7 BOREHOLE COMPLEX NEAR THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Fenix and Scisson, Inc., Tulsa, OK.
For primary bibliographic entry see Field 4B.
W83-02977

NEW METHOD SIMPLIFIES SLUDGE DISPOSAL.
Journal of the American Water Works Association, Vol 74, No 4, p 110-111, April, 1982. 3 Fig, 1 Ref.

Descriptors: *Sludge disposal, *Water treatment, *Land application, Land disposal, Air diffusion sludge liquefaction.

The air diffusion method of liquefying water treatment sludge overcomes some of the problems of sludge handling and disposal. This patented system consists of a pumping station to transfer the sludge from solids-contact basins, storage tanks with air diffusion grids, a compressed air blower, and a tank truck sludge hauler. Air is blown through the sludge in the storage tanks to liquefy it for easy transfer to the hauling truck. There it is mixed by compressed air during transit to farm land. Sludge of 46% dry solids (calcium and magnesium carbonates) is spread uniformly in a 0.8 m wide swath. The air diffusion system may be readily fitted to any size water treatment plant. (Cassar-FRC)
W83-03070

WASTEWATER INJECTION WELL PROBLEMS, PROCESSES AND STANDARDS,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
J. A. Oberdorfer, and F. L. Peterson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208827, Price codes, A07 in paper copy, A01 in microfiche. Technical Report No 146, December 1982. 141 p, 42 Fig, 22 Tab, 36 Ref, 8 Append. OWRT A-093-HI(1), 14-34-0001-2113.

Descriptors: *Injection well, *Wastewater disposal, *Clogging, Groundwater, Field tests, Filtration, Carbonates, *Hawaii, *Nitrogen gas binding.

Near-well processes, their relationship to clogging, and technology appropriate under Hawaiian hydrogeologic conditions for dealing with clogging were examined in this study. The first phase involved monitoring of functioning injection well systems on Oahu and pointed out deficiences in the areas of (1) site selection, (2) well design and construction, (3) injection well testing, (4) effluent quality control, (5) injection well monitoring and maintenance, and (6) injection well redevelopment. Monitoring of existing injection sites furthermore pointed out the need for construction of experimental injection well systems where more detailed studies could be made of injection clogging mechanisms. The second phase involved construction and operation of experimental injection well systems to investigate problems of injection well siting, design, testing, and redevelopment. Results show the need for selection of high initial injection capacity sites, standardization of injection testing to predict maintainable injection capacity, and well redevelopment. The third phase involved examination of near-well clogging processes and their implications for injection well operation and redevelopment. Results show that filtration of suspended solids is not a long-term cause of clogging as is generally cited in the literature. It is probably a short-term cause at the start-up of effluent injection. As injection continues, however, the microbial biomass becomes established and biodegrades the injected organic particulates. During the same period denitrifying bacteria become sufficiently established to produce significant amounts of nitrogen gas, which in turn produces a gas-bound zone about 0.5 to 1 m out in the injection stratum as revealed by the injection head gradient. Initially, most of the head loss is immediately adjacent to the well, but after several weeks it shifts to a region over 1/2 m from the well. With continued injection the nitrogen gas-bound zone slowly extends itself farther out into the injection stratum. Superimposed on this, but its effects masked in part by the gas binding, is dissolution of the carbonate porous medium.
W83-03102

AEROBIC THERMOPHILIC STABILIZATION OF SLUDGE VERSUS ANAEROBIC DIGESTION AND OTHER KINDS OF SLUDGE TREATMENT AT MIDDLE-SIZED PLANTS WITH RESPECT TO POWER CONSERVATION AND ECONOMY,
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W83-03121

LEACHING CHARACTERISTICS OF INDUSTRIAL METAL FINISHING WASTEWATER TREATMENT PLANT SOLIDS,
Whirlpool Corp., Benton Harbor, MI.
T. H. Goodgame, and P. W. Barnett.
Water Science and Technology, Vol 14, No 6/7, p 715-726, 1982. 7 Fig, 6 Tab, 3 Ref.

Descriptors: *Wastewater disposal, *Heavy metals, *Leaching, *Landfills, Waste dumps, Sanitary landfills, Metals, Metal finishing wastes, Industrial wastes.

The leaching characteristics of solids resulting from the treatment for discharge of wastewaters produced by typical large metal finishing facilities were determined. Samples were chosen so that the full range of both manufacturing processes and products produced was covered. The primary processes which contributed to the wastewater for treatment were phosphating in preparation for organic coating and pickling in preparation for application of porcelain enamel. These samples, along with a sandy loam soil as a control, were placed in lysimeters. Distilled water was used as the leaching liquid, selected as most representative of landfill conditions. Liquid was passed through the samples at the rate of one liter per week. Based on the area of the lysimeter this rate was equivalent to a percolation rate of 510 cm per year. Leachate samples were analyzed for twenty-two different parameters: pH, TSS, COD, alkalinity, chloride, nitrate, phosphate, sulfate, Al, B, Ca, Cd, Cr, Cu, Fe, Mg, Mn, Na, Ni, Pb, Ti, and Zn. Results indicate that the wastewater solids act very similarly to the soil used as a control. The leachate concentrations of heavy metals and the depletion of the heavy metals were such that this material would create no problems if disposed in an ordinary landfill, indicating that it is neither toxic nor hazardous. The time period of this experiment was equivalent to ten years of exposure in an ordinary landfill, and to a much longer period if deposited in a sanitary landfill. (Baker-FRC)
W83-03122

AN INTEGRATED LOW COST SYSTEM FOR TREATMENT OF POTATO PROCESSING WASTERWATER INCORPORATING ANAEROBIC FERMENTATION AND PHOSPHORUS REMOVAL,
Water Science Labs. Pty Ltd., Melbourne (Australia).
For primary bibliographic entry see Field 5D.
W83-03124

SIMULTANEOUS PASTEURIZATION - DIGESTION (SPD-PROCESS),
Niersverband, Viersen (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W83-03125

PROCESS INTEGRATION IN SLUDGE MANAGEMENT,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
R. I. Dick, D. L. Simmons, and Y. Hasit.
Water Science and Technology, Vol 14, No 6/7, p 765-779, 1982. 8 Fig, 1 Tab, 32 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Incineration, Costs, Wastewater treatment, Design criteria, Systems analysis, Model studies, Cost analysis.

Complex interactions occur between individual sludge treatment processes and other sludge management processes. Sludge treatment processes also interact with wastewater treatment processes. Consideration of those interactions has been facilitated by a computerized optimization scheme using models of process performance and cost based on fundamental design and operational variables. It was determined that the mean cell residence time of activated sludge processes and the retention time of anaerobic digesters should, with current energy costs, be as short as possible while assuring satisfactory operation. The additional cost of larger gravity thickeners is often offset by savings in anaerobic digestion and other process costs. The method by which sludge is transported to a point ultimate disposal has an important effect on identification of the lowest cost technique for sludge management. Based on available cost information, ocean disposal, where feasible, is nearly always costs effective, and sludge combustion is not. The cost of energy significantly affects optimal design of sludge treatment processes. (Baker-FRC)
W83-03135

5F. Water Treatment and Quality Alteration

SANITARY PROBLEMS IN RELATIONSHIP WITH TAP WATER DISTRIBUTED IN NEW OR RECENT BUILDINGS OF PARIS (PROBLEMS SANITAIRES POSES A PARIS PAR L'EAU POTABLE DANS LES IMMEUBLES NEUFS OU RECENTS),
Laboratoire d'Hygiene de la Ville de Paris (France).
A. M. Laurent, G. Montout, A. Spinasse, and B. Festy.
Techniques et Sciences Municipales, No 5, p 319-322, March, 1981. 4 Fig, 10 Ref. (No English Summary).

Descriptors: *Potable water, *Water distribution, *Impaired water quality, Water pollution sources, *Bacteria, Metals, *France, Paris.

New buildings in Paris, France, have been experiencing problems with the quality of their potable water. In many cases, there has been a degradation in tap water quality during the first few years following occupancy of new buildings. The relationship between technical sanitary controls of building installations and an analytical survey of the water distributed to 674 buildings in Paris was studied in 1979. The results demonstrate a relatively high percentage of high-level bacterial contamination (14%) and of physico-chemical problems with excess metals (30 %) in the water supplied to these buildings. Origins of these problems include defective disinfection, insufficient rinsing of new water systems, and persistent contaminations of specific installations, such as over-pressure systems and hot water tanks. Another problem which is occurring more and more frequently in new buildings is the presence of sediments composed primarily of mixtures of zinc (oxide and carbonate) and iron compounds. (Author's abstract)
W83-02844

TELECONTROL AND THE COMPUTER IN WATER SUPPLY (TELESURVEILLANCE ET ORDINATEUR AU SERVICE DES EAUX),
Societe Francaise de Distribution d'Eau (France).
A. Lepretre.
Techniques et Sciences Municipales, No 2, p 69-76, February, 1981. 3 Fig. (No English Summary).

Descriptors: *Water supply, *Automation, *Computers, Water conveyance, Water treatment facilities, Personnel, Telemetry, France, Remote sensing, Costs.

The Societe Francaise de Distribution d'Eau operates a public water supply service which is located for the most part in the Ile-de-France region. To best meet the system's need for constant control, the S.F.D.E. instituted a centralized telecontrol system at its drinking water facilities and then extended the system to include the sanitation service. A central computer located at Annet-sur-Marne, where S.F.D.E. operates a large plant treating water from the Marne River, controls the 250 pumping stations, reservoirs, and treatment plants through the use of a telephone system. Each of the facilities is equipped with a transmitter connected to the telephone system which keeps watch over several alarms. Whenever an alarm is activated, this information is forwarded by the transmitter to a computer located at Annet-sur-Marne. After identifying the affected points and alarms, the computer in turn forwards the alarms to on-call personnel, matching the geographical position of the affected facility to that of the personnel. This system has reduced personnel use to the strictly necessary, allowing for considerable savings. (Author's abstract)
W83-02846

THE ROLE OF DOC, UV ABSORPTION AND TOH MEASUREMENTS IN WATER POLLUTION CONTROL,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5D.
W83-02882

VOLATILIZATION OF ORGANIC TRACE CONTAMINANTS BY AIR STRIPPING FOR WATER RECLAMATION,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W83-02917

A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE DYNAMICS OF BREAKPOINT CHLORINATION IN DISPERSED FLOW REACTORS,
California Univ., Los Angeles. School of Engineering and Applied Science.
M. K. Stenstrom, and H. G. Tran.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-203414, Price codes: A08 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, April 1983. 155 p, 28 Fig, 17 Tab, 91 Ref, 1 Append. OWRT A-073-CAL(1).

Descriptors: *Chlorination, *Residual chlorine, Dispersed flow reactors, *Breakpoint chlorination, Mathematical models, Simulation analysis, Model studies, Dispersion, Hydrogen ion concentration, *Finite difference methods, *Wastewater treatment, Water treatment.

The dynamics of breakpoint chlorination were examined in three continuous dispersed flow reactors. The reactors were comprised of 1/2, 2 and 3 inch PVC pipe, which were 730, 41, and 23 feet long, respectively. Chlorination of ammonia at various chlorine to ammonia ratios were investigated over the pH range of 6.5 to 7.5. Seventeen experiments were performed in the three reactors over the course of the experimental investigations. Chlorine residuals, including free, monochloramine, dichloramine, and nitrogen trichloride and ammonia were analyzed simultaneously. To quantitatively characterize the breakpoint reactions, a mathematical model, consisting of eight simultaneous, quasi-linear, partial differentials equations was developed. The model was solved using an implicit finite difference technique. The reaction rate coefficients were treated as parameters, and were estimated using a search technique to minimize the sum of squares of the difference between the expected and measured values. The model can now be used to simulated continuous flow chlorination processes in order to develop process operating strategies to maximize or minimize any given experimental objective. (Snyder-California)
W83-02926

COLOUR AND TURBIDITY REMOVAL WITH REUSABLE MAGNETITE PARTICLES--IV. ALKALI ACTIVATED MAGNETITE--A NEW SOLID, REUSABLE COAGULANT-ADSORBENT,
Commonwealth Scientific and Industrial Research Organization, South Melbourne (Australia). Div. of Chemical Technology.
L. O. Kolarik.
Water Research, Vol 17, No 2, p 141-147, February, 1983. 5 Fig, 4 Tab, 9 Ref.

Descriptors: *Turbidity, *Coagulation, *Iron compounds, *Water treatment, Magnetite, Iron oxide, Color removal, Sedimentation, Flocculation, Alum, Polyelectrolytes.

Akali treated magnetite (Fe304) was effective in removing color and turbidity from river water during laboratory jar tests. The process consists of 4 steps: (1) brief premix of activated magnetite with water at pH 4-6, (2) addition of coagulant followed by further mixing, (3) sedimentation of flocs, (4) regeneration by magnetic separation and treatment with 0.1 M sodium hydroxide. The sedimentation rate of the magnetized particles was 10 times faster than in conventional alum flocculation. Turbidity removal increased with decreasing particle size. The optimum 10 ml per liter dose of magnetite added to raw water of 21 NTU turbidity produced turbidities (NTU) as follows: 17 with 15-50 micron particles, 14 with 6-15 micron particles, and 3 with 1-5 micron particles. Magnetite used in conjunction with alum or cationic polyelectrolytes improved the performance and reduced settling time of the coagulant mixture. (Cassar-FRC)
W83-02948

EFFECT OF SOLUTION CHEMISTRY ON COAGULATION WITH HYDROLYZED AL(III): SIGNIFICANCE OF SULFATE ION AND PH,
Syracuse Univ., NY. Dept. of Civil Engineering.
R. D. Letterman, and S. G. Vanderbrook.
Water Research, Vol 17, No 2, p 195-204, February, 1983. 12 Fig, 16 Ref.

Descriptors: *Chemical reactions, *Chemical coagulation, *Aluminum, Sulfates, Clay, Kaolin, Hydrogen ion concentration, Flocculation, Laboratory studies, Adsorption, *Water treatment, Chemistry of precipitation.

A laboratory study was conducted to investigate the effects of pH and the background sulfate ion concentration on the efficiency of flocculation of kaolin clay suspensions when aluminum salts are used. The results from these jar tests were used to develop a conceptual model which helps to explain the relative significance of these variables in the flocculation process. The conceptual model assumes that the adsorption of aluminum hydrolysis products on the clay particles determines the net surface charge of the particles and the total volume concentration of the suspension. The surface charge of the composite particles appears to be determined by the extent of the aluminum hydroxide precipitate coating and the surface charge of the component surfaces. Solution pH and specifically adsorbed anions, such as sulfate, were shown to have an important effect on the charge and amount of the adsorbed precipitate and hence on the net charge, volume concentration, and stability of the composite particles. (Carroll-FRC)
W83-02949

RATE CONSTANTS OF REACTIONS OF OZONE WITH ORGANIC AND INORGANIC COMPOUNDS IN WATER--I. NON-DISSOCIATING ORGANIC COMPOUNDS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. Hoigne, and H. Bader.
Water Research, Vol 17, No 2, p 173-183, February, 1983. 8 Fig, 6 Tab, 43 Ref.

Descriptors: *Ozonation, *Chemical reactions, *Organic compounds, Oxidation, Water treatment, Solutes, Kinetics, *Wastewater treatment, Laboratory studies.

In many countries, ozone is widely used for the treatment of drinking water and/or for oxidation of specified compounds in industrial wastewaters. In order to evaluate the advantages and risks of ozonation processes, kinetic data are needed to predict what products will remain in the water after specified durations of ozone applications. This study involved the measurement of the direct reactions of molecular ozone with solutes which do not dissociate. Rate constants of reactions of ozone with these non-ionized solutes, including aliphatic alcohols, olefins, chlorosubstituted ethylenes, substituted benzenes, and carbohydrates, were determined from the absolute rates with which ozone reacted in the presence of various concentrations of these compounds in water. They were tested by comparison with the relative rates by which pairs of these solutes are transformed by ozone. Different experimental methods were developed to determine such rate constants ranging from .02 to 100,000 per molar-second. Interferences between the direct reactions of ozone and reactions due to its preliminary decomposition to secondary oxidants could be eliminated. The kinetics of all the reactions studied are first order with respect to ozone and solute concentration. The rate of constants of many types of organic compounds in water are of the same order of magnitude as in organic solvents, although substituted benzenes react in water about 100 times faster. Comparisons of the rate constants with chemical structures of the reacting groups show that all reactions of ozone are highly selective and electrophilic. (Carroll-FRC)
W83-02950

RATE CONSTANTS OF REACTIONS OF OZONE WITH ORGANIC AND INORGANIC COMPOUNDS IN WATER--II. DISSOCIATING ORGANIC COMPOUNDS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. Hoigne, and H. Bader.
Water Research, Vol 17, No 2, p 185-194, February, 1983. 8 Fig, 3 Tab, 29 Ref.

Descriptors: *Ozonation, *Chemical reactions, *Organic componds, Oxidation, *Water treatment, Kinetics, Phenols, Amino acids, Hydrogen ion concentration, Laboratory studies, *Wastewater treatment, Industrial wastes.

In many countries, ozone is widey used for the treatment of drinking water and/or for oxidation of specified compounds in industrial wastewaters. In order to evaluate the advantages and risks of ozonation processes, kinetic data are needed to predict what products will remain in the water after specified durations of ozone applications. At the pH of biological systems or natural waters, the reaction rates observed for reactions of acidic and basic organic compounds are often regulated by the small fraction of deprotonated species present. This paper presents comprehensive lists of rate constants of reactions of ozone with such acidic and basic organic chemicals as amines, amino acids, carboxylic acids, and phenols dissolved in water. The second-order rate constants were found to increase with pH, as does the degree of deprotonation of the dissolved substances, for example, from 1 to 100 per molar-second for formic acid and from 0.2 to 2 per molar-second for glyoxalic acid. The kinetics of all the reactions studied were first order with respect to ozone and solute concentrations. The rate constants of many types of organic compounds in water are of the same order of magnitude as in organic solvents. The rate and selectivity of ozonation reactions are highly dependent on the pH of the water or solute. (Carroll-FRC)
W83-02951

THE HEALTH SIGNIFICANCE OF VIRUSES IN WATER.
Water Research, Vol 17, No 2, p 121-132, February, 1983. 161 Ref.

Descriptors: *Viruses, *Public health, *Water treatment, Fate of pollutants, Pollutant identification, Water pollution effects, Reviews, Water quality, Indicators, Epidemiology, Water reuse, Bacteria, Human diseases.

The virologic aspects of water quality were reviewed by a committee of 16 persons from 9 countries. Transmission of viral diseases by water has been proved by epidemological documentation for hepatitis, gastroenteritis, and adenovirus infections. In general, waterborne viral disease has been under-reported, especially in developing countries. The long incubation periods and sub-clinical symptoms of some diseases also contribute to the difficulties of gathering epidemiological evidence. The minimum human infectious dose (MIF) of virus has not been established. A few workers assume an MIF of 1 PFU; most evidence points to a higher value, which depends on age, state of health, diet, and immunity. Most of the study group did not feel that the low-level transmission hypothesis is realistic in estimating health risks of viruses in water. Treatment of water to meet coliform standards does not necessarily prevent outbreaks of viral diseases or giardiasis. Although viruses have been detected in swimming water which meets coliform standards, documentation of resulting disease is scarce. In edible shellfish no practical alternative to coliform specifications has been proposed. Even though levels of bacterial indicators are often not proportional to virus levels, many have been useful to monitor the virucidial effects of water treatment. These indicators include coliforms, standard plate count, acid-fast bacteria, Clostridium perfringens spores, coliphages, cyanobacteria, and other phages. Research needs in the field of waterborne viral disease are: improved monitoring systems, suitable quality limits, epidemiology and methods of transmission, and the use of purified wastewater in irrigation. (Cassar-FRC)
W83-02959

SANITARY MICROBIOLOGIC ASSESSMENT OF WATER DESALINATION BY DISTILLATION (SANITARNO-MIKROBIOLOGICHESKAYA OTSENKA DISTILLYATSIONNOGO METODA OPRESNENIYA VODY),
Institute of General and Municipal Hygiene, Moscow (USSR).
For primary bibliographic entry see Field 3A.
W83-03010

OBTAINING AN ANALYTICAL GRASP OF WATER DISTRIBUTION SYSTEMS,
Pitometer Associates, Columbia, MD.
M. Siedler.
Journal of the American Water Works Association, Vol 74, No 12, p 628-630, December, 1982. 1 Tab.

Descriptors: *Water distribution, *Planning, Systems analysis, Management, Water management, Water supply, Metering, Leakage, Valves, Hydrants, Maintenance.

Described are engineering studies that can be undertaken to address the dual problems of pipeline leakage and long range planning for improving distribution systems. An efficiently maintained system - one that is properly designed to meet phased needs - will save money and produce maximum revenue. Methods for locating leakage include listening surveys and flow rate measurements. Water audits are also useful; they locate not only leaks but also defective valves in the field, and defective hydrants are identified. Loss-of-head tests and fire hydrant flow tests also yield vital information. These studies and measurements must be correlated and used intelligently in designing improvements. In designing main feed lines, it is necessary to consider how the water can be brought to certain sections where it is needed without undue loss os head from friction, in sufficient quantities, and under all conditions of draft that are likely to occur. Computations can be made covering the period for which improvements are intended so that each stage can be completed by the time it is needed. A definite program results in an orderly procedure for construction of new work. A long range plan provides opportunities to take advantage of buying material under favorable markets. Once needs are analyzed, a program of improvements can be implemented in an orderly, efficient manner. (Baker-FRC)
W83-03066

DRINKING WATER AND LEGIONNAIRES' DISEASE,
Health Effects Research Lab., Cincinnati, OH.
A. P. Dufour, and W. Jakubowski.
Journal of the American Water Works Association, Vol 74, No 12, p 631-637, December, 1982. 4 Fig, 5 Tab, 52 Ref.

Descriptors: *Public health, *Drinking water, *Bacteria, Legionella pneumophila, Surface waters, Potable water, Water pollution control, Public health.

Up-to-date information is provided on control measures which can be used to combate legionellosis, the various forms of the disease, and methods of detecting the presence of the bacteria. Legionella pneumophila is a gram-negative, slow growing, rod-shaped bacterium that does not grow on ordinary laboratory media. Sources of legionella include surface waters, both pristine and contaminated, and potable waters. A summary of the number of outbreaks and cases of legionellosis associated with potable water that have occurred since 1979 is prepared. The outbreaks reported in the literature have been few in number. Most of the outbreaks have been linked to shower heads or water taps in hospital environments. Another group of legionellosis cases was associated epidemiologically with a hotel. Free chlorine has been found effective in controlling Legionella in potable water. Intermittent high temperature treatment in a hospital's hot water distribution system without chlorination also appeared to be an effective short-term means for controlling the level of Legionella. A number of the major outbreaks of legionellosis were associated with cooling towers and evaporative condensers, and a cumbersome, but relatively easy method was available for examining water samples. It is recommended that institutions with high-risk populations be made aware of the potential health hazards associated with legionella in finished water. (Baker-FRC)
W83-03067

COMPARATIVE INACTIVATION OF SIX ENTEROVIRUSES BY OZONE,
Grand Island Biological Co., NY.
D. Roy, R. S. Englebrecht, and E. S. K. Chian.
Journal of the American Water Works Association, Vol 74, No 12, p 660-664, December, 1982. 10 Fig, 2 Tab, 8 Ref.

Descriptors: *Public health, *Viruses, *Ozonation, *Drinking water, Water treatment, Disinfection, Enteroviruses, Poliovirus, Coxsackievirus, Echovirus.

A study was undertaken to determine the relative ozone resistance of six enteroviruses, two from each of the subgroups poliovirus, coxsackievirus, and echovirus. Inactivation by ozone was determined by using a continuous flow, completely mixed reactor under controlled laboratory conditions. Ozone was present at 0.15 mg/L at pH 7.2 and 20 degrees C. Tests showed a decreasing order of resistance as follows: poliovirus 2, echovirus 1, poliovirus 1, coxsackievirus B5, echovirus 5, and coxsackievirus A9. The resistance of poliovirus 2 was about forty times that of coxsackievirus A9. The resistance of two viral types within a given subgroup was also found to vary markedly. An increase in residual ozone concentration resulted in a decrease in resistance to inactivation. The temperature of the suspending medium or water was noted to affect viral inactivation by ozone. An increase in temperature resulted in a decrease in viral resistance when all other environmental conditions were constant. The effect of pH on viral resistance was investigated with two viral strains. The viruses were noted to be more resistant at lower acidic pH than at neutral pH. The resistance of poliovirus to inactivation by ozone at a residual concentration of 0.15 mg/L was about 4 times greater at pH 4.3 than at pH 7.2. (Baker-FRC)
W83-03068

RECENT DEVELOPMENTS IN WATER TREATMENT IN FRANCE,
Compagnie Generale des Eaux, Paris (France).
M. Rapinat.
Journal of the American Water Works Association, Vol 74, No 12, p 610-617, December, 1982. 13 Fig, 3 Tab, 70 Ref.

Descriptors: *Water treatment, *Drinking water, *Ozonation, Chlorination, Ozone, Chlorine, Trihalomethanes, Activated carbon, Paris, *France, Filtration, Taste, Water quality.

Source water near Paris, France, has deteriorated in recent years, causing a reevaluation of traditional chemical treatment of drinking water. Good results have been obtained by using natural biological purification in conjunction with activated carbon, thus reducing the amount of chemical reagents needed and also improving the taste of the water. Ozone is used before filtration, before activated carbon filtration, and after carbon filtration. The cost of these improved techniques is only about 6% more than that of traditional chemical reagent techniques. There is a greater homogeneity of treated water because the new treatment trains are less sensitive to fluctuations in raw water quality than are the traditional processes that depend on chemical elimination of pollutants. There was as much as a 15% increase in the removal of organics, and the extent of purification compared with raw water has increased to 80%. There is lower bacterial growth in the treated water and therefore a reduction in the amount of residual chlorine needed for protecting the distribution system. There is a marked improvement in the taste of the water, resulting from the disappearance of combined chlorine and an inprovement in micropollutant removal. There is also a clear reduction in the trihalomethane content of the distributed water. (Baker-FRC)
W83-03069

BUILDING WATER AND SANITATION PROJECTS IN RURAL GUATEMALA,
Hazen and Sawyer, Miami, FL.
A. W. Karp, and S. B. Cox.
Journal of the American Water Works Association, Vol 74, No 4, p 163-169, April, 1982. 1 Fig, 1 Tab, 3 Ref.

Descriptors: *Water supply, *Rural areas, *Training, Water resources development, *Guatemala,

Developing countries, Agua del Pueblo, Sanitation, Drinking water, Springs, Planning, Water distribution, Financing.

The Agua del Pueblo, a private, nonprofit technical assistance organization, has been promoting water and sanitation services in rural Guatemala since 1972. First, a technology appropriate for the individual village is chosen, with consideration of minimizing construction and operating costs and maximizing use of local labor and construction materials. It is desirable to find a water source which does not require treatment or use of expensive forms of energy. In highland Guatemala gravity flow systems and hydraulic rams have been widely developed. Hand pumping of groundwater is less feasible because water tables are at a depth of 30-60 m. Complementary activities include latrine construction, health and hygiene education, and reforestation of the watershed above the spring. An essential part of the program is training of village personnel for routine maintenance and of paraprofessional technicians for bridging the gap between civil engineers and the native population. After graduating from the 35-hour per week, 6-month training course, technicians are capable of planning, design, and construction of village water projects. Self-financing techniques for construction and maintenance has been successful. A water project involves community participation at all stages: initial promotion, feasibility studies, legal arrangements, planning, census and mapping, surveying, final design and budget preparation, and construction. (Cassar-FRC)
W83-03071

TOXICOLOGICAL PROBLEMS ASSOCIATED WITH ALTERNATIVE METHODS OF DISINFECTION,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W83-03087

THE ROLE OF FILTRATION IN PREVENTING WATERBORNE DISEASE,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
G. S. Logsdon, and E. C. Lippy.
Journal of the American Water Works Association, Vol 74, No 12, p 649-655, December, 1982. 10 Fig, 3 Tab, 26 Ref.

Descriptors: *Human disease, *Filtration, *Drinking water, *Water treatment, Public health, Microorganisms, Giardiasis, Chlorine, Chlorination, Bacteria, Review, History, Filters, Turbidity, Disinfection, Water pollution sources.

Pilot plant data and results from full scale operation are presented to illustrate the effectiveness of various forms of filtration in reducing microbial populations to concentrations that are easily controlled by disinfection. A review of old as well as new literature shows that slow sand filters, rapid granular media filters, and DE filters are capable of removing bacteria, viruses, and cysts if designed and operated properly. Each of these filtration processes can be rendered ineffective by faulty design or by careless or improper operation. At slow sand filtration plants, controlling filtration rates and filtering to waste after filters are scraped are important aspects of filter operation. Effective coagulation and control of the filtered water's turbidity at rapid rate filter plants will do much to assure that filtered water has a minimum number of microorganisms. The operator can control turbidity of the water more precisely by monitoring turbidity at each filter rather than at the clearwell. The particle size of diatomaceous earth (DE) selected for precoat and body feed influences removal of bacteria by DE filters. In order to remove viruses most efficiently by means of DE filtration, of some modification of either the filter aid or the raw water is needed. Raw water can be modified using cationic polymer. DE filtration is effective for removing cysts if an adequate precoat is used and the septum is kept very clean. (Baker-FRC)
W83-03088

A MODEL OF COSTS FOR TREATING DRINKING WATER,
Municipal Environmental Research Lab., Cincinnati, OH.
R. M. Clark, and P. Dorsey.
Journal of the American Water Works Association, Vol 74, No 12, p 618-627, December, 1982. 6 Fig, 14 Tab, 9 Ref.

Descriptors: *Drinking water, *Water treatment, *Cost analysis, Mathematical equations, Design criteria, Legislation, Maintenance.

The Safe Drinking Water Act of 1974 emphasizes the need to consider costs when promulgating regulations. In response to the concerns about the costs of technological requirements, research was undertaken to develop cost data associated with 99 unit processes for treating drinking water. These estimates were then used as a basis for regression analysis estimates calculated on equations derived for operations and maintenance costs and capital costs annualized at 8% over a 20 year amortization period. The equations and some typical applications of them are reported. Predesign estimates can be used to compare the cost of two treatment plants with similar water treatment goals and to choose the most cost-effective treatment alternative. A series of cost equations for conventional water treatment unit processes were developed that are accurate to approximately three significant figures. (Baker-FRC)
W83-03089

COSTS FOR SUPPLYING ALTERNATIVE COMMUNITY WATER AND SANITATION SYSTEMS IN BRAZIL,
For primary bibliographic entry see Field 6C.
W83-03092

MICROBIAL QUALITY OF WATER IN OLD WELLS AND THE PUBLIC WATER DISTRIBUTION SYSTEM IN THE U. S. VIRGIN ISLANDS,
Caribbean Research Inst., St. Thomas, VI.
H. Winters, and I. Isquith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208587, Price codes: A02 in paper copy, A01 in microfiche. Technical Report No 8, October 1981. 16 p, 8 Tab, 3 Ref. OWRT A-015-VI(1), 14-34-0001-1150.

Descriptors: *Cisterns, *Water harvesting, *Shallow wells, *Virgin Islands, Water wells, Drinking water, Domestic water supply, Microbial analysis, Public health, Coliforms, Streptococcus, Salmonella.

The Virgin Islands public water supply must meet the published standards in the provisions of the Safe Drinking Water Act (Public Law 93-523). The objective of this study was to determine whether there exists a potential health hazard to users of the Virgin Islands public water supply and old water wells. These old wells which were built in the early 1900's could serve as an alternate water source in watershort areas. Coliform bacteria were used as the reference indicator for bacteriological quality. The presence of fecal streptococcus and Salmonella spp. was ascertained as potential indicators of water quality. The public water distribution system and old wells did not generally meet the microbiological standards set forth in the Safe Drinking Water Act. Fecal streptococcus and Salmonella spp. were excellent indicator organisms of fecal pollution. A potential health hazard is believed to be associated with the public water distribution system in St. Croix and St. Thomas.
W83-03098

MICROBIAL ANALYSIS OF DOMESTIC CISTERN WATER IN THE U. S. VIRGIN ISLANDS,
Caribbean Research Inst., St. Thomas, VI.
H. Winters, and I. Isquith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208595, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 7, January 1981. 19 p, 9 Tab, 2 Ref. OWRT A-014-VI(1), 14-34-0001-0150.

Descriptors: *Cisterns, *Water harvesting, Water storage, *Virgin Islands, Microbial analysis, Public health, Heterotrophic bacteria, Algae, Protozoa, Drinking water, Coliforms, Salmonella, Streptococcus, Potable water.

A significant proportion of the water supply in the U.S. Virgin Islands comes from the rainfall which is stored in cisterns. Since cistern water is not part of the public distribution system, it is not covered by the Safe Drinking Water Act (Public Law 93-523). The objective of this study was to determine whether cistern water supplies pose a potential health hazard to their users. The cistern water supplies were studied to assess the types of heterotrophic bacteria, algae, and protozoa that may be present. The bacterial study was directed towards identifying those organisms capable of causing disease in water supplies. Total coliform, fecal streptococcus and Salmonella sp. were enumerated. The presence of coliform bacteria, fecal streptococcus and Salmonella sp. in most of the cistern water supplies suggested a potential health problem. Algae and protozoa were found in several cistern waters, which indicated a high level of microbial diversity. These complex ecosystems suggested a continuous input of carbon and energy sources into the cisterns. The pollution of these cistern water supplies seemed to be of extreme significance, which has been overlooked by those involved in ascertaining the microbial quality of all drinking water in the U.S. Virgin Islands.
W83-03099

CHARACTERIZATION AND TREATABILITY OF THE BY-PRODUCTS OF CHLORINATION OF NATURALLY OCCURRING HUMIC SUBSTANCES,
Massachusetts Univ., Amherst. Water Resources Research Center.
F. A. DiGiano, P. C. Uden, W. C. Saracen, and E. L. Coker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208868. Price codes: A06 in paper copy, A01 in microfiche. Publication No 134, December 1982. 102 p, 34 Fig, 21 Tab, 27 Ref, 2 Append. OWRT A-117-MASS(1), 14-34-0001-0123.

Descriptors: *Chlorine, *Chlorinated hydrocarbons, *Chlorination, *Humic acids, *Halogens, Fulvic acids, Chemical analysis, Chemical properties, Chemical reactions, Adsorption, Molecular structure, Massachusetts, Wastewater treatment, Water treatment.

One method for meeting the new USEPA regulation controlling trihalomethane (THM) conentration is to remove the naturally occuring humic substances which react with chlorine to form THM's. In this research, humic substances obtained from three widely separated sites in, respectively, Amherst, Lee, and Middleton, Massachusetts were characterized as to their potential to form THM's, and, in the case of Amherst and Lee samples, as to their adsorbability on activated carbon. The similarity in THM production of fulvic acids from the same source suggested a relationship between drainage area and water chemistry. However, little difference was also found from source to source, implying that the reaction with chlorine is not very dependent on the structural characteristics of the humic substances. Only the lowest molecular fractions of humic substances were adsorbable to any extent. Mathematical analysis was used to show that unfavorable isotherms can result from competitive adsorption among components in a mixture. Treatment to remove THM precursors should include consideration of both reactivity toward chlorine and adsorbability of various molecular weight fractions in the mixture. In this study, the higher molecular weight fractions produced the most THM but were the least adsorbable. Therefore, these fractions should be targeted for removal by coagulation.
W83-03106

5G. Water Quality Control

THE SUCCESSES OF INCREASED WASTEWATER TREATMENT PLANT CON-

STRUCTION ON THE RHINE (ERFOLGE VERSTARKTEN KLARANLAGENBAUS AM RHEIN),
K. G. Malle.
Wasser, Luft und Betrieb, Vol 26, No 7/8, p 12, July/August 1982. 1 Tab, 3 Ref. (No English Summary).

Descriptors: *Wastewater treatment facilities, *Water pollution control, *Water pollution prevention, *Wastewater treatment facilities, Rivers, Rhine river, *Federal Republic of Germany, Water quality control, Pulp and paper industry, Organic compounds, Dissolved solids, Humic acids, Chlorides, Halogens, Chlorine, Drinking water, Hydrocarbons.

The Working Committee of Rhine Waterworks stated in its 1981 annual report that the total pollution loading of the Rhine river with dissolved organic matter had decreased by 50% since 1974. Oxygen content and ammonium concentration had also improved. This phenomenon was more apparent in the lower Rhine than in previous years and was achieved through the construction of wastewater treatment plants and changes in production procedures in the paper industry, resulting in a reduced discharge of lignosulfonic acids. Heavy metal pollution has ceased to be a problem for waterworks on the banks of the river. Between 1973 and 1981, dissolved organic carbon content decreased by approximately 550 tons/day (130 tons/day of this in lignosulfonic acids) and humic acids increased by about 260 tons/day. Hydrocarbon content did not change appreciably. Miscellaneous organic substances were reduced from approximately 430 to approximately 90 tons/day. In 1982, 70% of organic pollution consisted of humic acids, and future studies should concentrate on these. Organochlorine compounds decreased greatly after 1973, but have been at an almost constant level for the last few years; they consist mainly of larger organic molecules with a low chlorine content, such as chlorolignin. A research program undertaken by large chemical companies in the Rhine catchment area together with the Federal Ministry for Research and Technology is studying which substances in which industrial wastewaters are difficult to remove by drinking water treatment. Chloride content is still problematic for waterworks, particularly because of fluctuations in concentration. France's recent promise to stop discharge of at least 20 kg/sec of chloride should provide some improvement. (Gish-FRC)
W83-02802

WATER AND AIR RENEWAL IN RESERVOIRS (LES RESERVOIRS D'EAU POTABLE. 1-LE RENOUVELLEMENT METHODIQUE DE L'EAU ET DE L'AIR DANS LES RESERVOIRS),
Compagnie Generale des Eaux, Paris (France).
J. Fontaine.
Techniques et Sciences Municipales, No 3, p 151-158, March 1981. 11 Fig, 2 Ref. (No English Summary).

Descriptors: *Storage reservoirs, *Water quality control, *Aeration, *Filtration, Simulation analysis.

Maintenance of water quality in storage reservoirs necessitates methodical renewal of the stored water. A reduced model was used in a systematic study designed to determine the location of inlet and outlet branches in reservoirs which would ensure proper blending of the stored water. Various conventional reservoir shapes were tested. Studies with blowers resulted in the development of an air renewal and filtration system which has been implemented on a 45,000 cubic meter reservoir. Operational data from this application resulted in improvement of the use of the equipment, making the system both reliable and operable at only modest expense. The equipment significantly reduces the number of bacteria in the air coming into contact with stored water in large reservoirs. (Carroll-FRC)
W83-02815

LAKE ERIE OXYGEN DEPLETION CONTROVERSY,
Canada Centre for Inland Waters, Burlington (Ontario).
J. Barica.
Journal of Great Lakes Research, Vol 8, No 4, p 719-722, 1982. 1 Fig, 5 Ref.

Descriptors: *Oxygen depletion, *Phosphorus, *Lakes, Hypolimnion,, Water quality control, *Lake Erie, Anaerobic conditions, Pollution load, Trophic state, Eutrophication.

A workshop on the response of Lake Erie hypolimnetic anoxia to phosphorus controls held at the Canada Center for Inland Waters, Burlington, Ontario, December 2-3, 1981, confirmed the desirability of reducing P in the lake and validated the feasibility of the 1978 Great Lakes Water Quality Agreement's goal of restoring aerobic conditions to bottom waters of the central basin on a year-round basis. No revisions in the present strategy were recommended. It was agreed that oxygen conditions in the lake are related to degree of P input control, but there were differences of opinion regarding the degree of response. The unpredictability of natural processes makes it difficult to accurately predict future hypolimnetic oxygen conditions. Some conclusions reached in the 12 presentations were: temporary anoxia could occur in localized areas in years of unfavorable meteorological conditions, oxygen conditions have generally improved during 1978-80, and late summer oxygen conditions are likely to improve. Several authors claimed that decreases in P loading would have minimal effect on oxygen conditions because oxygen depletion rates are affected by physical factors such as the ratio of lake volume to sediment area, thickness and temperature of the hypolimnion, and trophic state. (Cassar-FRC)
W83-02824

DEFINING COST-EFFECTIVE SALINITY CONTROL PROGRAMS,
Agricultural Research Service, Prosser, WA. Irrigated Agriculture Research and Extension Center.
R. G. Evans, W. R. Walker, and G. V. Skogerboe.
Journal of the Irrigation and Drainage Div
Proceedings of the American Society of Civil Engineers, Vol 108, No 4, p 265-272, December, 1982. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Salinity, *Cost analysis, *Colorado River Basin, Imperial Dam, Water quality control, *Salinity control, Arizona.

The optimal salinity control program in
93-320 projects in the Upper Colorado River Basin would cost about $30 million annually and pr
about 1.2 million metric tons of salt per year from entering the Colorado River System. These figures were derived from a comparison of the annual costs of salinity control in the Upper Basin with annual salinity related damages in the Lower Basin. The goal of removing 2-3 million metric tons of salt per year from flows passing into the Lower Basin cannot be achieved cost effe
with the proposed salinity control projects. Without any salinity control measures the probable maximum salt concentration at Imperial Dam is 1210 mg per liter. It is cost effective to control salinity only up to about 1030 mg per liter. Therefore, it would be necessary to allow the salinity levels at Imperial Dam to rise by as much as 180 mg per liter to balance control costs with downstream damages. (Cassar-FRC)
W83-02829

EFFECTIVENESS OF TREATMENT TO MEET PHOSPHORUS OBJECTIVES IN THE GREAT LAKES,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
S. C. Chapra, H. D. Wicke, and T. M. Heidtke.
Journal of the Water Pollution Control Fede
Vol 55, No 1, p 81-91, January, 1983. 3 Fig, 12 Tab, 17 Ref.

Descriptors: *Phosphorus, *Lake restoration, *Cost analysis, Water quality control, *Great Lakes, Eutrophic lakes, Model studies, Optimization, Water pollution sources, Nonpoint pollution sources, Urban runoff, Storm wastewater, Economic evaluation.

A least cost phosphorus control program for the Great Lakes, capable of achieving water quality objectives, was calculated using mathematical models, optimization techniques, and economic information. The system was considered as 11 interconnected segments, each with individual total P objectives. The least cost strategy relies on a mix-
of point source and diffuse source controls and on zoned, rather than uniform, treatment. The optimal degree of treatment varies widely among the 11 basins. Total annual costs for the optimum
$378 million ($187 million for point
$31 million for rural runoff control, and $160 million for urban runoff control). The rate of treatment costs accelerates rapidly with increasingly stringent water quality objectives.
f the objectives could be achieved for
% of the total cost of the optimal treatment program. (Cassar-FRC)
W83-02830

THE USE OF WATER QUALITY MODELS IN MANAGEMENT DECISION MAKING,
Environmental Research Lab., Athens, GA.
T. O. Barnwell, Jr, and P. A. Krenkel.
Water Science and Technology, Vol 14, No 9-11, p 1095-1107, 1982. 6 Fig, 21 Ref.

Descriptors: *Model studies, *Decision making, *Water management, *Water quality control, Planning, Mathematical models, Management decisions, Pesticides, Hazardous wastes, Water quality.

The use of water quality models in three manage-
ts is described: screening, planning and design. Screening models are illustrated by describ-
ethodology applicable to large areas of land and another applied to a large number of chemicals. The application of models in a planning con-
ated by a local planning agency's use
developing nonpoint source control strategies
deral government's use in assessing potential exposure to a pesticide. Development of design criteria is illustrated by summarizing the long history of model use to develop effluent limits in the Holston River basin in Tennessee. Experi-
e has shown that wherever possible model results should be confirmed with independent data or analyses. A thorough and objective review of a model application can be significant factor in the acceptance of a model's results, both in the specific application being considered and in future applica-
ilar models. (Baker-FRC)

REMOVAL OF PESTICIDES AND HERBICIDES BY MEANS OF ADSORPTION ON ACTIVATED CARBON,
Chemviron S.A., Brussels (Belgium).
D. V. Hei
Water Science and Technology, Vol 14, No 9-11, p 1527-1532, 1982. 4 Fig, 3 Tab.

Descriptors: *Organic compounds, *Leaching, *Soil contamination, *Groundwater contamination, Herbicides, Pesticides, Filtration, Activated carbon, Purification, Sweden.

Drums containing toxic liquid herbicide and pesticide waste were buried at Techmatorp, Sweden. The material leaked into the ground, resulting in soil contamination over an area of about 100,000 sq m. For treatment, a plan was developed to inject water into the contaminated soil and collect it in a storage reservoir. The collected wastewater would then be purified by granular activated carbon and
cled for reinjection. The actual installation consists of multi-media prefilters, two adsorbers working in series, and a transfer vessel containing
ctivated carbon, allowing the exchange of an exhausted load for a reactivated one using only one tanker. Upon saturation the activated carbon is thermally reactivated. The adsorbed organics are
erated and the adsorption capacity of the activated carbon is restored, allowing re-use of the carbon. The soil decontamination system works in closed circuit. The treated water is re-injected into the contaminated soil, and after percolation, is
in a storage tank from where it is
back into the treatment unit. When heavy rainfall occurs, water injection is not needed. The

treated water is discharged to a nearby sewage works. The phenoxy acid concentration in the washing groundwater decreased by a factor of 100 during the three years of treatment. (Baker-FRC)
W83-02857

APPLICATION TO ESTUARINE AND COASTAL WATERS,
Water Research Centre, Stevenage (England).
For primary bibliographic entry see Field 5B.
W83-02865

APPLICATION TO RIVERS AND UNDERGROUND WATERS,
Brussels Univ. (Belgium). Lab. of Hydrology.
J. L. Marivoet, F. De Smedt, A. Van der Beken, J. Dirickx, and W. Van Craenenbroeck.
Water Science and Technology, Vol 14, No 9-11, p 1073-1094, 1982. 5 Fig, 113 Ref.

Descriptors: *Model studies, *Water management, *Water quality control, Groundwater management, Rivers, Mathematical models, Planning, Policy making.

Mathematical models are described for determining water quality in rivers and groundwaters derived from the mass balances. For rivers a one dimensional transport equation is derived. Different methods of parameter estimation are considered, and more recent techniques are introduced. For the application of water quality models to river management two groups of models are considered. These are the simulation models and the optimization models. The Bedfore-Ouse quality models represent one application. Practical and theoretical applications have been made in England, Germany, the United States and Belgium. For groundwaters, several applications of water quality transport models are discussed, and the use in groundwater management is considered. The various models presented range from simple mass balance models to very complex sets of non-linear partial differential equations with time variant parameters and from simulation models to optimization models. Progress in water quality monitoring will permit the application of real-time water quality models, which can be of great help for short term management of water intake points and can help to avoid short but serious degradations of the water quality. (Baker-FRC)
W83-02866

LEGAL AND ADMINISTRATIVE CONTROL ASPECTS OF OIL POLLUTION,
Department of Energy, London (England). Petroleum Engineering Div.
A. D. Read.
Water Science and Technology, Vol 14, No 9-11, p 133-1157, 1982. 1 Fig, 3 Tab, 13 Ref.

Descriptors: *Water pollution control, *Legal aspects, *Administration, Decision making, Oil spills, Water pollution sources, Oil, Refineries, Industrial wastes.

The nature of the releases of oil to marine and fresh water environments that can occur during the production, transportation and refining of crude oil and from the distribution, use and ultimate disposal of its products are considered. The primary concern historically has been with persistent oils because of the visible contamination of the sea, especially inshore waters, and of beaches by oil spilled on them or reaching them from a spillage further out at sea. International Law as it relates to the control of oil pollution on a global and regional basis is considered, with particular stress on international customary law. Oil reaches marine and fresh water environments through natural releases, operational discharges, non-point sources and accidents. Various pollution prevention controls are noted, along with the role of national government and regional convention in the enforcement of pollution control measures. Pollution from dumping operations, refineries, ballast and slops reception facilities and other industrial and municipal waste discharges is examined. Mutual assistance efforts in responding to oil spill incidents are outlined. (Baker-FRC)
W83-02868

THEME 5: WATER POLLUTION CONTROL IN DEVELOPING COUNTRIES: REPORT OF THE SESSION CONVENOR,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6F.
W83-02873

LEGAL AND ADMINISTRATIVE ASPECTS,
National Swedish Environment Protection Board, Solna.
L. Brynoff, and B. Hawerman.
Water Science and Technology, Vol 14, No 9-11, p 1319-1934, 1982.

Descriptors: *Legal aspects, *Administration, *Developing countries, Water management, Policy making, Political aspects, Botswana.

The need for sound legislation and competent administration in order to achieve successful water management are discussed. Two case studies are presented, one from the Botswana Meat Commission at Lobatse which includes an abattoir and a cannery with a tannery attached as a separate unit, and the second in Molepolole, a major village of Botswana where a hospital, schools and government buildings are serviced by a new sewerage system. It is inferred from these cases that operational water pollution control must be based on certain important elements. For instance, there must be pollution control legislation based on a general consensus in these matters. There must be administrative authorities to provide for the needed expertise and law enforcement. There must be laid down recognized procedures for the handling of matters in various situations. It is noted that the situation varies from country to country and solutions to water pollution control problems must be tailored to suit the actual situation. It follows that while many of the points made are taken for granted in some countries, there is still a long way to go in other countries in organizing operational water pollution control. (Baker-FRC)
W83-02874

WATER POLLUTION CONTROL IN DEVELOPING AREAS - TRAINING AND EDUCATION,
Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Wasserbau.
K. Poppinghaus.
Water Science and Technology, Vol 14, No 9-11, p 1325-1335, 1982. 5 Tab, 9 Ref.

Descriptors: *Water pollution control, *Wastewater treatment, *Developing countries, Education, Training, Management, Water management.

Experience in developing the threshold countries has demonstrated that training and further education in natural sciences and engineering have preeminent and decisive importance. Training, further education and instruction in the area of water pollution control should be considered as a central point in every policy of aid for development. Training and further education must be carried out at university, specialized school and trade school sectors in order to achieve a hierarchically structured training and personnel that have been expertly trained in all areas. Specialized schools should train staff for practical related planning and decision-making employment in sewage and water works, because usually for using soft technology in water pollution control there is no need of highly sophisticated, trained staff from universities. A long term strategy for establishing this training scheme in developing countries guarantees only that the conditions in water quality and sanitation management can be retained and further developed. These long term and expensive measures of training in the developing country itself do not, however, cover the current need for well trained personnel. A number of suggestions of measures which have been established in the general field of education are cited. Two major areas of activity in a communication and health/hygiene education program are the coordination of the staff and community auxiliary guidance material, manual, visual aids and teaching aids, and the organization at all levels and through all appropriate channels of health and hygiene education. Programs for the operation and maintenance of the water supply and sanitation systems in the developing world are cited. (Baker-FRC)
W83-02875

WATER POLLUTION CONTROL IN DEVELOPING AREAS: PROBLEMS AND NEEDS,
J. R. Simpson.
Water Science and Technology, Vol 14, No 9-11, p 1353-1373, 1982. 10 Fig, 1 Tab, 17 Ref.

Descriptors: *Water pollution control, *Developing countries, *Wastewater treatment, Planning, Education, Training, Water management, Water quality, Water supply.

The wholesomeness of water supplies is essential for the control of many water-related diseases in developing countries. Proper handling of wastes is an essential part of good water pollution control programs. High kills of pathogens can be achieved during storage in batch composing latrines, aerobic composting windrows and waste stabilization lagoons. While waterborne sewage systems are highly convenient and quickly remove wastes from the immediate environment, these are expensive, and sewage treatment is required before final disposal can be made. Satisfactory on-site and off-site excreta handling systems do exist, some of which can be adapted progressively as water service levels increase. Proper training is needed for operators and technicians, the maintenance of plant and the early control of industrial wastes. Pollution control procedures should only be adopted after assessing all local circumstances together with the historical experiences of other areas. Serious problems can arise when rural areas are developed into urban conurbations. These problems can be reduced if taken into consideration at the initial planning stages. Whenever possible the use of mechanical and electrical equipment should be avoided. Legislation to control industrial wastes should be available before any problems develop in that area.(Baker-FEC)
W83-02876

MINERALIZATION PROBLEMS IN THE PWV COMPLEX - THE IDENTIFICATION OF VIABLE SOLUTIONS BY MEANS OF A SUITE OF MATHEMATICAL MODELS,
Steward, Sviridov and Oliver, Johannesburg (South Africa).
C. E. Herold.
Water Science and Technology, Vol 14, No 9-11, p 1525-1526, 1982.

Descriptors: *Minerals, *Model studies, *Water quality, *South Africa, Flushing, Runoff, *Water pollution sources, Pretoria, Witwatersrand, Economic aspects, Salts, *Salinity control.

Mineral pollutant loads have risen to intolerable levels in the water in the Pretoria-Witwatersrand-Vereeniging (PWV) complex. With the onset of the rainy season there is a pronounced first flush phenomenon, whereby salts accumulated in the catchment are washed off. The problem is compounded by the feedback effect, whereby effluents are recycled into the supply, with consequent build-up of salinity. Without some form of numerical model it is not possible to plan measures to improve the position. A suite of models was developed using meteorological data as the basic input. These models simulate at key points in the system, for any demand horizon, the monthly or daily salt concentrations associated with a wide variety of alternative management strategies. Incorporated into the models are the economic parameters relating salinity in the water supply to the costs incurred by consumers who have to use water of poor quality. A method has been evolved whereby the costs and benefits to consumers resulting from various water resources and pollution control planning and management options can be objectively compared. It was determined that within the PWV region the flow weighted average increase in TDS concentration during one usage cycle is 500 mg/liter; more than half of the TDS load originating in the southern PWV region is derived from diffuse

sources attributable to human activities; the storage of salts in the soil moisture zone and their transport via interflow play a significant role in the routing of diffuse source mineral pollutants through a catchment; and a strong correlation has been found between industrial water demand and the rate at which diffuse source salts are generated. (Baker-FRC)
W83-02881

EFFECTS OF WATER EXCHANGE ON WATER QUALITY IN CHANNEL CATFISH PONDS,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
C. E. Boyd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196493, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Auburn Univ. Ala. March 1983. 9 p, 1 Fig, 2 Ref. OWRT A-083-ALA(1), 14-34-0001-2101.

Descriptors: *Aquaculture, *Water quality control, Water use, Nutrient removal, *Catfish ponds, Channel catfish.

Nutrient and organic matter removal from catfish ponds by water exchange or biological extraction was investigated. Separate trials were conducted to determine losses of added phosphours, nitrate, nitrite, ammonia, and chemical oxygen demand. Chloride was added to ponds as an inert tracer to estimate the efficiency of water exchange. In spring (March - April), average water temperature and plankton biomass were low (15.1C and 10 ug/1 chlorophyll a), and water exchange at 134 m super 3/hour per hectare for 72 hours removed concentrations faster than in situ biological processes. In summer average water temperature and plankton biomass were high (29.5C and 101 ug/1 chlorophyll a), and biological extraction of nutrients and organic matter was equally as effective as water exchange in reducing concentrations. Water exchange at 134 super 3 hour per hectare was inefficient in reducing phytoplankton densities in ponds during the summer months because of regrowth of plankton community. Water exchange as practiced cannot be recommended as a water quality management technique in channel catfish ponds during the summer months.
W83-02897

PROBLEMS, ISSUES, CONSTRAINTS, AND BARRIERS TO WATER QUALITY PLANNING AND MANAGEMENT IN URBAN AND URBANIZING AREAS (SMSA'S) IN TENNESSEE,
Tennessee Univ., Knoxville. Graduate School of Planning.
For primary bibliographic entry see Field 6B.
W83-02899

THE INFLUENCE OF WATER EXCHANGE ON WATER QUALITY AND FISH PRODUCTION IN CHANNEL CATFISH PONDS,
Auburn Univ., AL.
M. V. McGee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196675, Price codes: A04 in paper copy, A01 in microfiche. Ph.D Thesis, March 1983. 50 p, 10 Fig, 11 Tab, 27 Ref. 3 Append. OWRT A-083-ALA(2), 14-34-0001-2101.

Descriptors: *Catfish farming, *Catfish ponds, Catfish, *Water exchange, *Water quality control, Water quality data, Water quality management, Channel catfish, Fish reproduction.

Water exchanges totaling 0, 1, 2, or 4 pond volumes were applied at 2 week intervals for 14 weeks (July - September) to 0.04 hectare ponds stocked with 10,625 channel catfish per hectare and fed up to 65.5 kg/hectare per day. Water samples taken 48 hours following water exchange indicated that levels of chlorophyll a (Chl a), chemical oxygen demand (COD), total ammonia nitrogen (TAN), and nitrite (NOsub 2-N) were not different ($P > 0.05$) between treatments. Secchi disc visibilities were not greater ($P > 0.05$) within treatments following exchanges. Fish production was not improved ($P > 0.05$) by water exchange. Biological processes which also contributed to nutrient and COD removal in ponds masked effects of water exchange. Water budgets calculated for the ponds indicated an average of 85.5 cm of water was required to maintain water levels in ponds independent of water exchange during a 5 month period(May - September).
W83-02905

COMBINED WATER-FERTILIZER MANAGEMENT TO MINIMIZE NON-POINT WATER POLLUTION WHILE ACHIEVING HIGH CROP PRODUCTION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 2I.
W83-02907

POLLUTION POTENTIAL RANKING OF BARNYARDS FOR PRIORITY WATERSHED PLANNING,
Wisconsin Univ.-Madison. Dept. of Soil Science.
T. C. Daniel, and R. M. Motschall.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-202358, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center Technical Report WIS WRC 83-02, Univ. of Wisconsin, Madison, 1983. 15 p, 4 Fig, 2 Tab, 14 Ref. OWRT A-093-WIS(1), 14-34-0001-0153

Descriptors: *Animal wastes, *Barn wastes, *Manure, *Water pollution prevention, *Watershed management, Agricultural watersheds, Dairy industry, Farms, Feedlot runoff, Feedlot wastes, *Phosphorus.

A barnyard ranking method using adjusted available P concentrations was developed so that pollution control funds can be allocated according to the 'worst first' approach. The ranking method was derived from soil data that was obtained from waterways and background locations near impact areas. Mean waterway available P concentrations ranged from 41 to 470 ppm. A distinct nutrient grandient exists in waterway soil with distance from barnyards so data obtained near the impact area are representative of waterway trends. Mean background available P concentrations ranged from 66 to 140 ppm. Background data indicate that excessive landspreading of manure occurred near barnyards. A critical management level (CML) was defined from background data collected near impact areas. The CML is a standard to establish a cutoff level between critical and noncritical sites. The proposed CML (150 ppm) is the best estimate based on available data.
W83-02915

HYDROLOGICAL AND ENVIRONMENTAL CONTROLS ON WATER MANAGEMENT IN SEMIARID URBAN AREAS -- PHASE II,
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 4D.
W83-02918

PRELIMINARY PROJECTIONS OF THE EFFECTS OF CHLORIDE-CONTROL STRUCTURES ON THE QUATERNARY AQUIFER AT GREAT SALT PLAINS, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. E. Reed.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-151431, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-120, 1982. 45 p, 8 Fig, 11 Tab, 25 Ref.

Descriptors: *Computer models, *Water quality, *Saline lakes, *Surface-groundwater relations, Aquifers, Brines, Groundwater movement, Solute transport, Geohydrology, Data collections, Model studies, Projections, *Oklahoma, Great Salt Plains.

About 1,200 tons of chloride per day are added to the salt load of the Salt Fork of the Arkansas River at Great Salt Plains Lake from natural sources. The source of this chloride is brine discharge from the rocks of Permian age in the vicinity of the lake. The U. S. Army Corps of Engineers has planned a chloride-control project. The Corps requested that the U. S. Geological Survey use a digital model to project the effects of the chloride-control plan on ground water. Ground-water flow and ground-water transport models were calibrated to represent the Quaternary aquifer which is the near-surface part of the flow system. The models were used to project the effects of planned chloride-control structures. Based on model results, ground-water levels are projected to rise as much as 19 feet. However, these water-level rises will occur only in areas near three reservoirs. Changes in ground-water level caused by the project will be small over most of the area. Chloride concentration of ground-water is projected to increase by over 90,000 milligrams per liter at one location. However, significant increases in chloride concentration are projected to be limited to areas where the ground-water already has high chloride concentrations. (USGS)
W83-02988

THE QUALITY OF WATER OF THE RIO BRAVO BASIN (LA CALIDAD DE LAS AGUAS DEL BAJO RIO BRAVO),
For primary bibliographic entry see Field 6E.
W83-03019

WATER QUALITY IMPROVEMENT IN THE FIRTH OR FORTH: A DISCRIMINANT FUNCTIONAL ANALYSIS,
Napier Coll. of Commerce and Technology, Edinburgh (Scotland).
P. A. Read, and T. Renshaw.
Environmental Pollution, Series B, Vol 4, No 4, p 291-301, 1982. 1 Fig, 5 Tab, 4 Ref.

Descriptors: *Outfall, *Ocean dumping, *Wastewater disposal, Fate of pollutants, Water pollution sources, Edinburgh, *Scotland, Firth of Forth, Statistical analysis, Wastewater treatment, Primary wastewater treatment, Water quality.

Water samples were collected at 8 sites in the intertidal zone on the south shore of the Firth of Forth in 1973-75 and 1978-80, before and after introduction of a sewage treatment scheme for Edinburgh, Scotland. The new treatment system, primary treatment and discharge of effluent through a 2800 m sea outfall, replaced 9 short outfalls discharging raw effluent near the shore. The mean sample values for fecal coliforms, BOD, inorganic suspended solids, organic suspended solids, inorganic phosphate, nitrate plus nitrite, and salinity measured before and after were compared by discriminant functional analysis to assess the extent of change. Mahalanobis distance measures were used for this comparison. At 2 of the 8 sites water quality was significantly improved by construction of the sewage disposal system. These sites were especially high in fecal coliforms, 11,963 and 43,658 per 100 ml. At 2 other sites differences before and after were almost statistically significant. After the change, there were no statisically significant differences in general water quality among the sites. A fertilizer factory, inshore outfalls for crude sewage, and suspended solids and nitrogen from rivers were continuing sources of pollution, not affected by the construction of the longer outfall. (Cassar-FRC)
W83-03059

EVALUATION OF EPA UN-IONIZED AMMONIA TOXICITY CRITERIA,
Szumski (Dan) and Associates, Walnut Creek, CA.
D. S. Szumski, D. A. Barton, H. D. Putnam, and R. C. Polta.
Journal of the Water Pollution Control Federation, Vol 54, No 3, p 281-291, March, 1982. 6 Fig, 3 Tab, 19 Ref.

Descriptors: *Water quality standards, *Fish, *Ammonia, *Toxicity, Water pollution effects, Gills, Effluent limitations, Standards, Alkalinity, Water temperature, Temperature, Alkalinity, Hydrogen ion concentration.

The EPA Red [illegible] mg per liter of un-ionized ammonia at the gill surface of fish as the water quality cri[illegible] protection of salmonid fisheries. Total [illegible] levels that achieve this standard are [illegible] various pH at 20C. This paper re[illegible] chronic toxicity [illegible] values are overly restrictive in warm [illegible] ies during periods of high temperature [illegible] pH, adding significantly to costs of [illegible] wastewater treatment plants. A more suitable [illegible] native is suggested. It considers ammonia concentrations as a function of pH, temperature, and alkalinity. For example, at 20C and alkalinit[illegible] 200 mg per liter CaC03, the allowable total ammonia concentrations would be 2.7 mg per liter at pH 8.5; 5.0 mg per liter at pH 8.0; and 10.0 mg per liter at pH 7.5. Permissible ammonia values are lower for water at high temperature and/or alkalinity. The Red Book criteria are 4 mg per liter total ammonia at pH 7 and 0.1 mg per liter at pH 8.6. (Cassar-FRC)
W83-03091

6

ALUM CONTROL OF INTERNAL PHOSPHORUS LOADING IN A SHALLOW LAKE,
Washington Univ., Seattle. Dept. of Civil Engineering.
E. B. Welch, J. P. Michaud, and M. A. Perkins.
Water Resources Bulletin, Vol 18, No 6, p 929-936, December, 1982. 8 Fig, 2 Tab, 20 Ref.

Descriptors: *Phosphorus removal, *Alum, *Lake restoration, Shallow water, Eutrophic lakes, Macrophytes, Algae, Chemical precipitation, Flocculation, Aquatic plants, Fate of pollutants, Water treatment, Water quality control.

Alum was applied at 5.5 mg per liter in September 1980 to eutrophic Long Lake, Washington (2 m mean depth, 137 ha area) to control internal phosphorus loading. Mean summer total P and chlorophyll a decreased from 76 and 27 micrograms per liter, respectively, in 1978 before treatment to 29 and 14 micrograms per liter. Mean summer Secchi transparencies increased from 1.6 to 2.2 m. After treatment cryptomonads, diatoms, and green algae became relatively more abundant at the expense of blue-green algae. Macrophyte biomass, reduced by 84% after a 4 month drawdown in 1979, returned to the previous levels within a year after alum treatment. It is not known whether decomposition of macrophytes during the winter of 1982 will increase the P loading in the following summer. If this loading does not occur, it can be assumed that the aluminum hydroxide floc was an effective control of P. The increased transparency may encourage proliferation of macrophytes, with negative impacts in recreational use and relapse of P during decomposition. Long-term improvements may be produced by harvesting the macrophytes each season or by removing the top half meter of the sediment layer. (Cassar-FRC)
W83-03140

A MODELING APPROACH FOR STORM WATER QUANTITY AND QUALITY CONTROL VIA DETENTION BASINS,
Princeton Univ., NJ. Dept. of Civil Engineering.
R. A. Ferrara, and A. Hildick-Smith.
Water Resources Bulletin, Vol 18, No 6, p 975-981, December, 1982. 7 Fig, 5 Tab, 7 Ref.

Descriptors: *Storm water, *Detention reservoirs, *Urban hydrology, Model studies, Mathematical models, Storm wastewater, Design criteria, Nonpoint pollution sources, Water quality control, Water management.

A mathematical model is presented to help designers plan storm water detention basins for the dual purposes of storm water quality and quality control. Results show that, for a given basin, removal increases as storm frequency increases, i.e., storm size decreases. For large storms, particles have less time and greater depths over which to settle in the basin. The degree of pollutant removal for any particular constituent (for example, solids, COD, total Kjeldahl nitrogen, and total phosphor[illegible] a function of the particle size for that constituent. For particles < 1 micron little removal is obtained; [illegible]5 microns, nearly complete re[illegible] Solids removal is high; total P [illegible] design procedure is illustrated [illegible] 1 sq mi watershed undergoing [illegible].

RUNOFF AND WATER QUALITY FROM TRIPLE SOIL LANDFORM UNITS ON MANCOS SHALE,
Bureau of Land Management, Denver, CO. Div. [illegible]cial Studies.
For primary bibliographic entry see Field 2J.

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

USE OF EPA'S CAPDET PROGRAM FOR EVALUATION OF WASTEWATER TREATMENT ALTERNATIVES,
Tulane Univ., New Orleans, LA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W83-02804

THE USE OF WATER QUALITY MODELS IN MANAGEMENT DECISION MAKING,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5G.
W83-02847

APPLICATION TO RIVERS AND UNDERGROUND WATERS,
Brussels Univ. (Belgium). Lab. of Hydrology.
For primary bibliographic entry see Field 5G.
W83-02866

MATHEMATICAL MODELLING OF ESTUARIES AND COASTAL WATERS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W83-02867

MANAGEMENT OF EXISTING RESERVOIR SYSTEMS BY INTERACTIVE OPTIMIZATION,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
S. M. de Monsabert, M. H. Houck, and G. H. Toebes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-203398, Price codes: A10 in paper copy, A01 in microfiche. Technical Report No 149, March 1983. 195 p, 38 Fig, 25 Tab, 77 Ref, 6 Append. OWRT A-060-IND(1).

Descriptors: *Reservoir operation, *Objective function, *Probabilistic processes, *Optimization, Decision making, Eagle Creek Reservoir, Droughts, Floods, *Inflow forecasting, Indianapolis, *Indiana, *Simulation analysis.

A new methodology is developed for use in optimizing reservoir operations. This method utilizes an original function that is derived from reservoir managers' goals. By interpreting the operating desires of decision makers in terms of probabilistic benefits, Probabilistic Optimization Objective Functions (POOFs) are defined. One advantage of POOFs is that they do not require an extensive economic analysis. POOFs were developed for the Eagle Creek Reservoir located near Indianapolis, Indiana. For the Eagle Creek Reservoir case study the following conclusions may be drawn: 1. Probablistic Optimization Objective Functions (POOFs) were easily constructed. 2. Simulated POOF optimizations of daily operations reduced [illegible] significantly over heuristic policies when both had the advantage of ideal inflow forecasts. 3. POOF optimization results can be assembled into release rule curves capable of reducing droughts and floods to a greater extent than heuistic or historic policies. 4. Special POOFs which guide the reservoir operations during extreme conditions reduced the effects of simulated droughts and floods with ideal inflow forecast knowledge.
W83-02924

OPTIMAL ANNUAL OPERATION OF A WATER SUPPLY AND DISTRIBUTION SYSTEM,
Mekoroth Water Co., Haifa (Israel).
S. Meyers, and U. Shamir.
Advances in Water Resources, Vol 5, No 4, p 240-247, December, 1982. 6 Fig, 4 Ref.

Descriptors: *Water supply development, *Water distribution, Water resources development, Model studies, *Optimization, *Optimum development plans, Planning, Resources development, *Israel.

A model is described for determining the optimal operation of Israel's National Water System over 1 year, with monthly time increments. The water system contains the Main National Carrier which is about 250 km long from the Kinneret in the north to the Negev in the south, and some 25 regional water systems connected to it. Water is taken from the Kinneret and from two aquifers. Water transfers may take place between the National Carrier and regional systems, and between interconnected regional systems. The mathematical model of the system represents its monthly production and transfer capacities. Given the monthly demands which have to be met and the hydraulic constraints, the model determines the month-by-month operating plan, which minimizes energy costs over the year. The optimization model is formulated as a linear program. This necessitates several types of approximations and linearizations, which are described in detail. The optimal operating plan for 1977-78 is compared with the actual operation of the year, and conclusions are drawn from the comparison concerning the practicality and adequacy of the model's output and the potential for effective operation annd for energy savings. The analysis of the 1977-78 operation year indicates a potential savings of 6% of the total energy requirement for the system. It is felt that this is sufficiently high to warrant further effort in implementing the required planning program, in which the model would play a central role. (Baker-FRC)
W83-03062

TEN ECOSYSTEM APPROACHES TO THE PLANNING AND MANAGEMENT OF THE GREAT LAKES,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
B. J. Lee, H. A. Regier, and D. J. Rapport.
Journal of Great Lakes Research, Vol 8, No 3, p 505-519, 1982. 4 Fig, 47 Ref.

Descriptors: *Lakes, *Management, *Planning, *Great Lakes, Decision making, Water management, *Ecosystems, Environmental effects.

Ten ecosystem approaches are considered for Great Lakes basin management problems. Similarities, differences and at times, insufficiencies in these approaches are identified, and some general features of comprehensive ecosystem approaches for Great Lakes issues are recommended. The ecosystem approach bridges the disciplines of natural and human ecology to form an integrated or transdisciplinary approach to the study of natural systems. The general features of such approaches include concepts and methods of appropriate spatial and temporal scope as well as scale and detail; analytically, sufficient specification of the ecosystem with system to external naturally, sufficient specification of the ecosystem with respect to external natural processes and components, and ecosystemic man-nature interactions; holistically, adequate comprehension of internal evolutionary/successional processes, responsiveness/adaptiveness to external factors, and recovery sequences after relaxation of external stress; and information sets including maps of spatial ecosystem features, monitored time series of diagnostic features, models of relational/casual processes, and management case

studies. The approaches also include various aspects concerned with managment objectives, political-administrative processes, and disciplines/professions. (Baker-FRC)
W83-03082

6B. Evaluation Process

AN ECONOMIC ANALYSIS OF INTEGRATED FISHERIES MANAGEMENT: THE CASE OF THE LAKE MICHIGAN ALEWIFE AND SALMONID FISHERIES,
Hawaii Univ., Honolulu. Dept. of Agricultural and Resource Economics.
K. C. Samples, and R. C. Bishop.
Journal of Great Lakes Research, Vol 8, No 4, p 593-602, 1982. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Fish management, *Lake fisheries, *Economic evaluation, Benefits, Fisheries, Model studies, Recreation, Fishing, Commercial fishing, Sport fishing, Predation, Alewife, Salmon, Anadromous fish, Fish harvest, Fish populations, Trout, Salmonids, *Lake Michigan.

Salmonids in Lake Michigan consume an estimated 110-112 million pounds of alewives each year. To determine appropriate levels for salmonid stocking and harvesting and commercial alewife landings an optimal control model was developed. The model shows that: (1) in both fisheries optimal harvest benefits equalled marginal harvest costs, including any interfishery externalities imposed on the other fishery; (2) a lower alewife harvest is preferable in the joint case than if harvest rates were determined for both fisheries independently (increasing the salmonid harvest increases the available alewives); (3) obtaining a value of fish landed in each fishery is vital to computing the marginal social benefits. The marginal return social values per 5 pounds of fish are: salmonids, $4.10, and alewives, nearly zero. This indicates that it would be more economically efficient to use the alewife biomass as a salmonid food than as a commercial harvest. However, the economic viability of the lake's commercial fisheries is not considered in this model. (Cassar-FRC)
W83-02811

BALANCING BENEFITS AND EXPENDITURE IN WATER POLLUTION CONTROL,
C. Lefrou.
Water Science and Technology, Vol 14, No 9-11, p 1245-1255, 1982. 3 Fig, 29 Ref.

Descriptors: *Water pollution control, *Evaluation, *Economic aspects, Planning, Management, Water management, Decision making.

Variables existing in the differenct possible kinds of expenditures for the control of water pollution can fluctuate considerably within neighboring geographic areas for various reasons, such as the extent of water demand and the uses of the rivers by riparian owners. Expenditures include building, extension and maintenance of sewerage systems and urban sewage treatment works, sewerage construction in appropriate places, building industrial sewage treatment works and pretreatment facilities, removal of urban and industrial wastes to central disposal sites, laying out garbage dumps, treatment of rainwater in certain localities, and the maintenance of streams and their surroundings. Benefits derived from meeting these expenses include recreational benefits, diversionary uses, improved health, household benefits, industrial and commercial fisheries profits, and aesthetic benefits. Various methods of assessing the benefits provided by a pollution control policy are considered. (Baker-FRC)
W83-02862

THEME 3: THE ECONOMICS OF WATER POLLUTION CONTROL AND RESEARCH: INTRODUCTION BY THE SESSION CONVENOR,
Technische Hochschule, Darmstadt (Germany, F.R.). Inst. fuer Wasserversorgung, Abwasserbeseitigung und Raumplanung.
G. Rincke.
Water Science and Technology, Vol 14, No 9-11, p 1219-1223, 1982. 13 Ref.

Descriptors: *Water pollution control, *Planning, *Economic evaluation, Economic justification, Economic impact, Economic feasibility, Economic aspects, Decision making, Management, Administration, Water management.

There are three major objectives to be achieved in economic considerations on water planning and management; to improve the basis for decision making, to inform the political decision makers and the population regarding the necessity and future priorities of water pollution control and research, and to gain a realistic concept for cost allocation to the users of a technical system who may be partially responsible for regional pollution or those who are receiving special benefits. As an outcome of these considerations a multi-dimensional balance calculation has been developed in which the costs and benefits are evaluated separately in terms of economic effects, ecologic effects, social effects, and effects on regional development. The keys for an efficient transfer of knowledge seem to be to start from good and steady cooperation between the scientists involved, to test systems developed using practical examples according to the objectives that apply to a broad range of different problems, to correct the models after evaluation using the experience of practical tests, and to apply critical judgment to decide whether a system which has been designed to solve highly sophisticated problems can be simplified for use in less demanding applications. The relationship between the modelling and the value of information it provides should be clearly stated as positive, i. e., the benefit-cost relationship. It is concluded that the critical sense of the population, the growing interrelations among different fields of human activities, and the difficult control of complicated and dangerous side effects increases the need for such multi-dimensional side effects increases the need for such multi-dimensional planning of bigger projects. (Baker-FRC)
W83-02869

PROBLEMS, ISSUES, CONSTRAINTS, AND BARRIERS TO WATER QUALITY PLANNING AND MANAGEMENT IN URBAN AND URBANIZING AREAS (SMSA'S) IN TENNESSEE,
Tennessee Univ., Knoxville. Graduate School of Planning.
G. E. Bowen, G. E. Ferguson, and T. R. Gangaware.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196519, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Center Research Report No 90, Univ. of Tennessee, Knoxville, March, 1983. 204 p, 8 Fig, 7 Tab, 23 Ref. 2 Append. OWRT A-062-TENN(1), 14-34-0001-1145.

Descriptors: Water quality management, *Urban planning, *Institutional constraints, *Tennessee, Urbanizing areas, Literative reviews, *Surveys, Urban runoff, Low flows, Toxic substances, Industrial wastes, Abandoned dump sites.

Results are presented of a statewide study based on the systematic gathering of information on water quality management issues, problems, and barriers from three sources: a literature review, a questionnaire sent to experts within the state, and five case studies of '208' agencies within Tennessee. The study points out considerable variation among water basins, related to both water quality and the causes and treatment of problems. The major problems identified were: erosion and sediment, agricultural and forest runoff, sludge, flooding, construction runoff, low dissolved oxygen, flood plain development, eutrophication, algal growth and contamination from hazardous wastes. The major issues and barriers identified were: resistance to government regulations, lack of understanding regarding cause/effect relationships, imbalance between economic development and environmental protection, low priority of water quality, poor cooperation between industry and government agencies weak enforcement of regulations, and the need for stronger legislation. Major problems identified for metropolitan areas include: urban and construction runoff, low stream flows, toxic substances, abondoned dumps, and industrial contaminants. The barriers to obtaining high quality streams in metropolitan areas include: inadequate financial support, lack of political commitment, and well organized and financed opposition to water quality management. In addition, management agencies were fragmented, urban and rural conflicts existed, and suburban growth is poorly controlled.
W83-02899

AGRICULTURAL VS. HYDROPOWER TRADEOFFS IN THE OPERATION OF THE HIGH ASWAN DAM,
Metcalf and Eddy, Inc., Boston, MA.
K. Oven-Thompson, L. Alercon, and D. H. Marks.
Water Resources Research, Vol 18, No 6, p 1605-1613, December, 1982. 5 Fig, 7 Tab, 13 Ref.

Descriptors: *Reservoir operation, *Agriculture, *Hydroelectric power, Reservoir releases, Benefits, Cost-benefit analysis, *Aswan Dam, Nile River, *Egypt, Toshka Spillway, Model studies, Electric power production, Optimization, Seasonal variation, Flood control, Irrigation.

Present operation of the High Aswan Dam is based on satisfying irrigation needs, with hydropower generation as a residual benefit. Releases are very high in the summer months, 5.3 to 7.0 billion cu m, compared with 3.0 to 4.3 billion cu m the rest of the year. This paper defines the tradeoff between hydropower and agriculture under present water availability conditions and explores the results of various operating policies (reductions of 5, 15, and 25% in releases May through August) using a stochastic dynamic programming model. If summer irrigation allocations are reduced by 25% and cropping patterns are restructured to fit this reduction, a gain of 11-20% in firm monthly hydropower production is realized. Benefit/cost ratios from a 5-10% reduction in agricultural water are 0.71-0.86 if cotton irrigation only is reduced or if maize replaces rice. A slight increase of the value of hydropower from the present 0.035 Egyptian pounds per kWH would produce benefit/cost ratios of greater than unity. The Toshka Spillway, designed to serve as a safety valve for unusually high water conditions, appears to reduce power generation under the dynamic programming scheme. This aspect of the reservoir operation should be investigated. It is also recommended that the 300-400 GWH generated in summer replace the output of thermal power stations during that season, saving 30-40 million Egyptian pounds each summer. (Cassar-FRC)
W83-02934

OBTAINING AN ANALYTICAL GRASP OF WATER DISTRIBUTION SYSTEMS,
Pitometer Associates, Columbia, MD.
For primary bibliographic entry see Field 5F.
W83-03066

ECONOMIC AND ENVIRONMENTAL ISSUES OF THE PROPOSED EXTENSION OF THE WINTER NAVIGATION SEASON AND IMPROVEMENTS ON THE GREAT LAKES-ST. LAWRENCE SEAWAY SYSTEM,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 6G.
W83-03072

AN ASSESSMENT OF THE ECONOMIC MAGNITUDE OF ENVIRONMENTAL DAMAGE FROM ACID PRECIPITATION IN THE ADIRONDACKS,
F. C. Menz, and J. K. Mullen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208553, Price codes: A02 in paper copy, A01 in microfiche. Center for Environmental Research Completion Report, Cornell Univ., Ithaca, N.Y., May 1983. 11 p, 6 Ref. OWRT B-103-NY(1).

Descriptors: *Acid precipitation, *Economic aspects, *Fishery damages, *Adirondack Mountains,

Travel-cost method, Recreation demand, *New York, Lakes, Ponds, Environmental effects, Air pollution.

This research represents one of a few initial attempts to quantify economic damages resulting from increased acidification of lakes and ponds ostensibly due to acidic deposition. The Adirondack mountains have been identified as one of the most impacted and vulnerable areas in the northeastern U.S. to suffer acidification damages to its aquatic ecosystem. The focus of this research is the loss in economic welfare resulting from diminished recreational angling opportunities within the Adirondack fishery. An amended travel-cost model was applied to a survey of licensed anglers in New York State to determine the economic value of the fishery prior to the general acknowledgement of widespread acidification damages. The empirical model reflects the importance of available angling opportunities, as generally measured by water surface acreage, in explaining variations in demand patterns. Data pertaining to those water bodies that have become acidified were used together with the parameters of the empirical model to generate the change in visitation and economic value resulting from increased acidification. Annual losses in economic value due to the acidification-related reduction in recreational angling opportunities were estimated to be in the range of $1.6 to 3.2 million. For a variety of reasons, however, these estimates should be interpreted as a lower bound of the actual social losses incurred annually from acidification damages to this freshwater ecosystem.
W83-03095

THE NATIONAL RECREATIONAL FISHING BENEFITS OF WATER POLLUTION CONTROL,
Resources for the Future, Inc., Washington, DC.
C. S. Russell, and W. J. Vaughan.
Journal of Environmental Economics and Management, Vol 9, No 4, p 328-354, 1982. 1 Fig, 9 Tab, 33 Ref.

Descriptors: *Fishing, *Water pollution control, *Benefits, Water quality, Model studies, Biochemical oxygen demand, Water pollution effects, Legislation, Recreation, Cost-benefit analysis.

An effort to estimate the freshwater recreational fishing benefit subcategory is reported. The method used is potentially applicable to other subcategories. The method required the answers to the following questions: what are the mechanisms by which control of water pollution discharges creates benefits for actual or potential recreational fishermen; what tools and data could be used to capture those mechanisms; and what special difficulties would be encountered because of the emphasis on obtaining a national benefit total. A schematic view is presented of an attempt to estimate national recreational fishing benefits from water pollution control. Projections are made of the national impact of pollution control on total fishable fresh water and on its split among dominant species. Annual benefits of water pollution control accuring via recreational fishing are projected as well. One major problem in this type of program is the roughness of the connection between pollution discharges and predicted ambient conditions expressed in terms of fishery class. (Baker-FRC)
W83-03130

BENEFITS OF POLLUTION CONTROL ON MASSACHUSETTS' HOUSATONIC RIVER: A HEDONIC PRICING APPROACH,
Economic Research Service, Washington, DC.
P. R. Rich, and L. J. Moffitt.
Water Resources Bulletin, Vol 18, No 6, p 1033-1037, December, 1982. 1 Tab, 9 Ref

Descriptors: *Benefits, *Property value, *Water pollution control, Hedonic price theory, Regression analysis, Land appraisals, Recreation, Housatonic River, *Massachusetts.

The Hedonic price theory, a property value technique, was used to measure the benefits of a water pollution control project started in 1973 on the Housatonic River, Massachusetts. The methodology was based on the assumption that the benefits of improved water quality may be inferred from changes in land values. Since only the benefits enjoyed by land owners and recreationists are considered, the benefits are probably a lower bound estimate. Substantial benefits were calculated: $37 per acre for riparian land, $31 per acre for nonriparian land, and $600,000 for regional benefits. No abatement costs for ex-post distributional impacts were considered. (Cassar-FRC)
W83-03141

THE POTENTIAL IMPACT OF WATER REALLOCATIONS ON AGRICULTURE IN IDAHO,
Idaho Univ., Moscow. Dept. of Agricultural Economics.
R. B. Long.
Water Resources Bulletin, Vol 18, No 6, p 971-974, December, 1982. 1 Fig, 4 Tab, 2 Ref.

Descriptors: *Economic effects, *Farms, *Water allocation, Property value, Irrigation, Income, Monetary returns, Prices, Cropland, Dry farming, Arid lands, *Idaho.

The economic impact os shifting water allocations in Idaho from the present commitment to agriculture to other uses (power, industry, and recreation) was studied using an irrigated-dryland market equilibrium model. Reducing irrigated acreage and increasing dryland areage greatly reduces farm income and equity in farming where yields from irrigated and dryland farming are widely different. A reduction of irrigated acreage from 3.0 to 2.5 million acres would reduce farm income from $700 million to $430 million. A 16 and 2/3% decrease in land would decrease income by 38.6%. Values in the graphical model are based on 1967 prices and should be multiplied by 2.834 to correspond with present values. (Cassar-FRC)
W83-03143

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

PRICE, SOCIOECONOMIC, AND CLIMATIC INFLUENCES ON RESIDENTIAL WATER USE IN SOUTHERN ARIZONA,
Arizona Univ., Tucson.
For primary bibliographic entry see Field 6D.
W83-02894

FEDERAL WATER POLICY AND NEW MEXICO WATER,
For primary bibliographic entry see Field 6E.
W83-02922

THE LEGISLATIVE REALITY OF A NATIONAL WATER POLICY,
Senate, Washington, DC.
For primary bibliographic entry see Field 6E.
W83-02923

HYDROLOGIC AND WATER QUALITY MODELING FOR INSTREAM FLOW STRATEGIES,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
M. A. Medina, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-203422, Price codes: A20 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 183, North Carolina State Univ., Raleigh, December 1982. 246 p 90 Fig, 17 Tab, 89 Ref. 10 Append. OWRT A-117-NC(1), 14-34-0001-1135.

Descriptors: *Instream flow, *Instream aeration, *Frequency analysis, *Fisheries, Fishkill, Model studies, Rainfall-runoff relationships, Hydrologic data, Water quality, Biological oxygen demand, Computer programs, Dissolved oxygen, *North Carolina, Yadkin-Pee Dee River basin.

In the past, instream flow assessments have considered only water quantity and ignored fluctuating water quality. This study used data from the Yadkin-Pee Dee River basin, North Carolina to develop a framework to integrate water quality and quantity in the evaluation of instream flow needs. Synoptic rainfall data analysis allows characterization of storm event variables: volume, duration, intensity and time between events. Continuous hydrologic and water quality simulation models are used to produce three dimensional computer graphics as well as frequency and duration curves of streamflow and water quality constituents (e.g. dissolved oxygen, biochemical oxygen demand). Water quality criteria for freshwater fish are discussed, and a means of evaluating proposed flow and pollution levels is provided since continuous simulations can be used to predict violations of established stream standards. Programming considerations and instructions for operation of the models are presented at length.
W83-02927

A MODEL OF COSTS FOR TREATING DRINKING WATER,
Municipal Environmental Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5F.
W83-03089

COSTS FOR SUPPLYING ALTERNATIVE COMMUNITY WATER AND SANITATION SYSTEMS IN BRAZIL,
K. A. Demke, and D. T. Lauria.
Journal of the American Water Works Association, Vol 74, No 4, p 171-177, April, 1982. 8 Tab, 4 Ref.

Descriptors: *Developing countries, *Costs, *Economic aspects, Water distribution, Sanitation, *Brazil, Construction costs, Operating costs, Alternative planning, Planning.

Five alternative community water systems suitable for developing countries were compared, using detailed data collected during a study for a system installed in a small Brazilian town. Mathematical models developed from data describing 64 other Brazilian communities, most with populations of 5 to 10 thousand, were used to determine costs. The levels of service were: (1) public standpost, ventilated pit latrines, 25 liters per capita per day; (2) yard hydrants, pour flush toilets with soakaway, 50 liters per capita per day; (3) sanitary cores, pour flush toilets with septic tanks, 100 liters per capita per day, (4) sanitary cores, sewered pour flush toilets, 100 liters per capita per day; and (5) full plumbing, conventional sewage, 200 liters per capita per day. Total water and sanitation construction costs per capita were $21, $42, $74, $101, and $139 for the 5 levels of service, respectively. Annual operations costs were $43,000 to $190,000 for levels 1 to 5. Costs of constructing and operating the components of each system are given in detail to aid in choosing a system for each community according to individual needs. The largest increase in convenience and health benefits occurs between levels 1 and 2. Therefore, level 2 (yard hydrants) is a good choice where incomes are low, on the order of $1000 per year. These alternatives may be rapidly evaluated using computer programs. (Cassar-FRC)
W83-03092

6D. Water Demand

PRICE, SOCIOECONOMIC, AND CLIMATIC INFLUENCES ON RESIDENTIAL WATER USE IN SOUTHERN ARIZONA,
Arizona Univ., Tucson.
R. B. Billings, and W. M. Day.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196469. Water Resources Research Center Completion Report, Univ. of Arizona, Tucson, November 1982. 91 p, 19 Tab, 7 Fig, 33 Ref. OWRT A-104-ARIZ(1), 14-34-0001-1103.

Descriptors: *Water demand, *Elasticity of demand, *Water pricing, Municipal water, *Arizona, Climates, *Water use, *Residential water use, Model studies, *Marginal costs, *Block rate price

schdules, *Multiple regression demand models, Social values.

Several demand models for water in the presence of block rate price schedules were theoretically examined and empirically estimated. The alternative price concepts are average price and marginal price/difference. Difference is the implicit block rate tax or subsidy due to the availability-of-service charge and/or intramarginal blocks in the rate structure. Three variants of marginal price/difference were used: 1) marginal price and difference derived directly from the rate schedule for each quantity; 2) marginal price and difference derived from a regression of the total revenue function against corresponding values of quantity for each rate schedule; and 3) marginal price and difference as in (1) above, but with omission of observations where quantity is 'close' to the discontinuities in the rate schedule. This third variant of the model should produce unbiased estimates by eliminating observations where measurement error or omitted variables may cause quantity to fall in the 'wrong' use block, resulting in incorrect assigned values for marginal price and difference. Water use data and matching demographic and economic data for 1974-1980 were analyzed for each of 13 districts in Southern Arizona. Multiple regression demand models were estimated for each district and in a combined time-series, cross-section with each theoretical model. Strong statistical estimates of the price elasticities of demand were obtained for each model and district, along with estimates of the impact of various climatic, cultural, and economic influences on water use.
W83-02894

ESTIMATED WATER USE IN FLORIDA, 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
S. D. Leach.
Florida Bureau of Geology Map Series No 103, 1982. 1 Sheet, 6 Fig, 1 Tab, 5 Ref.

Descriptors: *Water use, *Consumptive use, *Water demand, Municipal water, Irrigation water, Industrial water, Water supply, Thermal powerplants, Saline water, Surface water, Freshwater, *Florida.

On the average 7,309 million gallons of freshwater is withdrawn for use in Florida each day for the combined use for public supplies, rural domestic and livestock, industrial self-supplied, irrigation, and thermoelectric power generation. The largest use of freshwater in Florida was for irrigation--2,997 million gallons per day which also is responsible for the greatest consumption 1,155 million gallons on the average each day. The remaining use of freshwater amounted to 1,859 million gallons per day for thermoelectric power generation; 1,361 million gallons per day for public supply; 781 million gallons per day for industrial use other than theromoelectric power generations; and 310 million gallons per day on the average, for rural domestic. (USGS)
W83-02990

SURFACE WATER AVAILABILITY AND FUTURE DEMAND ALONG THE BORDER FROM JUAREZ TO MATAMOROS (DISPONIBILIDAD DE AGUAS SUPERFICIALES Y SU DEMANDA FUTURO A LO LARGO DE LA FRANJA FRONTERIZA DESDE CIUDAD JUAREZ, CHIHUAHUA, HASTA MATAMOROS, TAMAULIPAS),
Escuela Superior de Agricultura Hermanos Escobar, Chihuahua (Mexico). Area de Manejo de Agua y Suelo.
For primary bibliographic entry see Field 6E.
W83-03022

6E. Water Law and Institutions

CLEAN WATER ACT - THE VIEW FROM HERE,
Johns Hopkins Univ., Baltimore, MD. School of Engineering.
A. Wolman.
Journal of the Water Pollution Control Federation, Vol 55, No 1, p 14-16, January, 1983. 4 Ref.

Descriptors: *Financing, *Water pollution control, Clean Water Act, Federal jurisdiction, State jurisdiction, Jurisdiction, Wastewater treatment, Economic aspects, Local governments, Water policy, Management.

Funding for water pollution control is shifting from the federal government to the states and their subdivisions. Annual expenditures for wastewater treatment were $0.5-1.5 billion (corrected for inflation) in 1943 when no federal grants were available and $2.43 billion projectd for 1984. This shows that considerable non-federal money has hisotrically been used for pollution control. The states must recapture their responsibility for financing wastewater treatment plant construction and operation. A handful of states (six) has raised over $2 billion through bond issues, refuting the contention that local governments are largely bankrupt. Other innovative financing approaches are being developed to suit local situations. The few cases of bankruptcy in municipalities are usually a result of poor management. The pollution control profession should resume its role within the familiar and historical frameworks which have been productive through the years, since it is unlikely that federal aid will be resumed. (Cassar-FRC)
W83-02832

LEGAL AND ADMINISTRATIVE CONTROL ASPECTS OF OIL POLLUTION,
Department of Energy, London (England). Petroleum Engineering Div.
For primary bibliographic entry see Field 5G.
W83-02868

LEGAL AND ADMINISTRATIVE ASPECTS,
National Swedish Environment Protection Board, Solna.
For primary bibliographic entry see Field 5G.
W83-02874

FEDERAL WATER POLICY AND NEW MEXICO WATER,
S. E. Reynolds.
In: Symposium on Coping With Federal Water Policy Changes, November 1982. Report No 158, February 1983. p 16-24. New Mexico Water Resources Research Institute, New Mexico State University, Las Cruces, NM.

Descriptors: *Water policy, *Water law, *Federal jurisdiction, Water resources development, Water rights, State jurisdiction, Administrative agencies, Administrative regulations, Operating policies, Legal aspects, Capital costs, Total costs, *New Mexico.

Since 1955, about $1.4 billion worth of water projects have been completed, are under construction or have been authorized for construction in New Mexico. The state will probably never need to seek authorization for major new irrigation projects, but it may need costly municipal and industrial water supply projects. The Department of Interior has pledged its support of western states water laws. However, of concern to New Mexico and other western states is DOI's proposed policy on cost-sharing on federal water projects. A Cabinet Council memorandum from DOI Secretary Watt recommends that the non-federal share of capital costs for municipal water supply be 100% of the cost; for industrial supply and hydroelectric power, the share be no less than 100%; and the share of cost for urban and rural flood protection and for agricultural water supply projects be variable but no less than 35%. To reduce the federal budget, the non-federal contribution would be required upfront. In reality, though, it would have a minimal effect on the deficit. Water administrators feel the federal government shouldn't make a profit on these projects unless the profits accrue to the water resources agencies in the affected states. In question also is whether these new cost-sharing guidelines would be applied to projects already authorized by Congress, such as the Colorado River Basin Project Act. Another concern is that of seeking Congressional approval for water projects before implementation by the administration. The author favors S.621, the Domenici-Moynihan bill to authorize the National Water Resources Policy Act of 1981 over the Cabinet Council's guidelines. (Atkins-Omniplan)
W83-02922

THE LEGISLATIVE REALITY OF A NATIONAL WATER POLICY,
Senate, Washington, DC.
J. Hughes.
In: Sumposium on Coping With Federal Water Policy Changes, November 1982. Report No 158, February 1983. p 9-15. New Mexico Water Resources Research Institute, New Mexico State University, Las Cruces, NM.

Descriptors: *Water policy, *Water law, *Federal jurisdiction, *Water rights, Water resources development, *Cost allocation, State jurisdiciton, Administrative agencies, Administrative regulations, Operating policies, Legal aspects, Capital costs, Total costs, Construction costs.

The nation's water policy is a hodge-podge of laws, policies and programs. Many of the issues and questions have been talked about for years, such as what can government do to meet the nation's water needs and make the best uses of existing resources; are water projects being developed, repaired, and operated economically and efficiently; what portion of the federal budget is allocated to water and are cost allocations, repayment and financing policies meeting today's requirements; how much cost recovery from users is possible; what impact will water shortages have on the legislative system; what is the role of water conservation; and do out laws need streamling to eliminate built-in conflicts of purposes of these laws. Complicating the resolution of these issues is the fact that there are eight committees and 11 subcommittees in the House dealing with water, and four major committees and seven subcommittees in the Senate. In addition, there are the secretaries of the Interior, Agriculture and Army; the administrator of the EPA; the Commerce and Transportation departments; and various city, county and state officials. However, there is agreement on many issues, i.e., water prices will continue rising; the courts will remain involved; energy development and urban expansion will continue placing severe pressure on western water resources; water shortages are a national not a western problem; and water projects will have a hard time competing with other projects for federal dollars. The author is confident that Congress is better educated on the issues and will change the laws that need changing. (Atkins-Omniplan)
W83-02923

LAWS AND INSTITUTIONS THAT REGULATE SURFACE WATERS IN MEXICO (COMMENTARIOS A LAS LEYES E INSTITUCIONES QUE REGLAMENTAN LAS AGUAS SUPERFICIALES DE MEXICO),
F. Oyarzabal.
Natural Resources Journal, Vol 22, No 4, p 999-1005, October, 1982. English summary.

Descriptors: *Water law, *Water allocation, *Water use, Legal aspects, Water permits, Appropriation, Constitutional law, Institutional constraints, Equitable apportionment, Regulations, *Mexico.

The Constitution of Mexico provides that waters within its national boundaries belong to the nation, which may transfer its authority over the waters to individuals for public use only by indemnification. The main federal water laws are the Federal Law of Water and the Law of Conservation and Groundwater. The Department of Agriculture and Water Resources has responsibility for the regulation of water appropriation, the administration of groundwater, and the operation of filter works, waterways, and irrigation systems. The Department of Agriculture and Water Resources has the authority to enter into agreements with states, municipalities, local communities, and private individuals for the construction of water diversion and

development works. However, the Department must observe priorities for water use specified by the Federal Executive. Water appropriations, which may be cancelled if the water is not used for the specified objective for two years, are granted based on propriety of use and beneficial results of such use. Titles of appropriation specify standards relating to water pollution, duration of appropriations, and their conditions, as well as cost and volume limits. Transfer of the appropriation and deviation from its conditions without the approval of the Department are prohibited. (Carroll-FRC)
W83-03004

THE QUALITY OF WATER OF THE RIO BRAVO BASIN (LA CALIDAD DE LAS AGUAS DEL BAJO RIO BRAVO),
F. Oyarzabal.
Natural Resources Journal, Vol 22, No 4, p 925-937, October, 1982. English summary.

Descriptors: *Water allocation, *Water quality, *International agreements, Salinity, Appropriation, Irrigation water, Irrigation effects, *Mexico, Rio Bravo Basin, Water Treaty of 1945.

The Rio Bravo basin supplies Mexico and the United States with drainage according to the unequal terms set forth in the Water Treaty of 1945. The Mexico United States Treaty for the Utilization of Waters in the Colorado and Tijuana Rivers and the Rio Bravo provides for the allocation of Rio Bravo waters between Fort Quitman, Texas and the Gulf of Mexico. Each country is assigned one-half of the drainage from the two international dams, Amistad an Falcon. However, while the United States is assigned the total drainage from all tributaries on U. S. land, it also receives one-third of the drainage of six of the eight tributaries on Mexican land, with the stipulation that this part cannot be less than 432 million cubic meters annually. Problems of salinity and drainage in Rio Bravo Basin Irrigation District Number 25, consisting of 200,000 hectares in the northeastern part of the state of Tamaulipas, on the coast of the Gulf of Mexico, have been increasing steadily since 1965. Although the effective salinity of the available water is still low enough so that the waters are usable for crop irrigation, the ground has been deteriorating at a rate of 1,000 hectares annually since 1979. Restoration of District 25 has been undertaken through construction of drains, which are slowing salinization, and through technical integral assistance, which promotes a technology designed to restore, increase, and conserve land productivity. Rising water contamination levels due to urban and industrial development, along with increased salinity, create an urgent need for a means of water quality control. The 1945 Treaty needs revision to include a provision for regulating the quality of river water and to make a more equitable distribution of the Rio Bravo's water. (Carroll-FRC)
W83-03019

SURFACE WATER AVAILABILITY AND FUTURE DEMAND ALONG THE BORDER FROM JUAREZ TO MATAMOROS (DISPONIBILIDAD DE AGUAS SUPERFICIALES Y SU DEMANDA FUTURO A LO LARGO DE LA FRANJA FRONTERIZA DESDE CIUDAD JUAREZ, CHIHUAHUA, HASTA MATAMOROS, TAMAULIPAS),
Escuela Superior de Agricultura Hermanos Escobar, Chihuahua (Mexico). Area de Manejo de Agua y Suelo.
C. A. Rincon Valdes.
Natural Resources Journal, Vol 22, No 4, p 847-853, October, 1982. 9 Tab. English summary.

Descriptors: *International agreements, *Water allocation, Water rights, Appropriation, *Mexico, *Rio Grande River.

Under the treaties of 1906 and 1944, the United States and Mexico allocate rights to water in the Rio Grande on the basis of its rate of flow. The Treaty of Water for the Juarez Valley of 1906 stipulates the division of water, allocating 60,000 acre-feet of water to Mexico annually. The Mexican-United States Water Treaty of 1944 led to the construction of dams along the Rio Bravo from Fort Quitman, Texas, to the Gulf of Mexico. These dams store and regulate most of the surface flow of the Rio Bravo. Hydrometric recordings at the dams show that between 1954 and 1966 Mexico appropriated 47% of the total Rio Bravo drainage and the United States appropriate 53%. Only 58% of the total drainage was put to beneficial use: 1,226 million cubic meters were lost at the Falcon Dam, and 2,035 million cubic meters were lost in the Gulf of Mexico. The 20 hydrometric stations on the Rio Grande calculate water accounts and, thus, international water rights. (Carroll-FRC)
W83-03022

ASSESSMENT OF ECONOMIC, SOCIAL, AND INSTITUTIONAL IMPACTS OF GROUNDWATER REGULATION OF THE TILLMAN TERRACE AQUIFER IN SOUTHWESTERN OKLAHOMA,
Oklahoma State Univ., Stillwater. Dept. of Geology.
For primary bibliographic entry see Field 4B.
W83-03033

CHANGES PROPOSED FOR WATER MANAGEMENT IN THE UNITED KINGDOM,
N. Rowntree.
Journal of the American Water Works Association, Vol 74, No 12, p 14, 36, December, 1982. 2 Tab.

Descriptors: *Water management, *Management planning, *Legal aspects, England, Wales, Engineering, Legislation, Water policy, Planning, Management, Political aspects, *United Kingdom.

After some 20 years the Water Acts of 1963 and 1973 had been implemented and a system of apparent finality had been reached in the United Kingdom. This system enabled the uncoordinated activities of about 2000 local service organizations to be incorporated into 10 regional water authorities that manage all aspects of water use and development. Now an additonal change is suggested by the government. The proposal would replace the existing large number of local government representatives with nine to fifteen members appointed by the minister of the environment to each regional authority. Local consultation would be provied by divisional advisory committees. The National Water Council and the Water Space Amenity Commission would be dissolved. Appropriate legislation would be introduced at the earliest opportunity so that the changes could become effective within a year. While the public has shown little awareness of or interest in the subject of water management, such proposed changes are of considerable importance to the water organizations, their personnel and others involved in assessing their obligations and opportunities. (Baker-FRC)
W83-03065

6F. Nonstructural Alternatives

GUIDELINES FOR THE REDUCTION OF WASTEWATER TAX (HINWEISE ZUR REDUZIERUNG DER ABWASSERABGABE),
Bundesverband der Deutschen Industrie e.V., Cologne (Germany, F.R.).
K. R. Kabelitz.
Wasser, Luft und Betrieb, Vol 25, No 3, p 18-24, March, 1981. 1 Fig, 9 Ref. (No English Summary).

Descriptors: *Pollution taxes, *Wastewater pollution, *Water law, *Effluents, Legal aspects, Economic aspects, Water quality standards, Federal Republic of Germany, Texas, Wastewater treatment, Water pollution control.

Ways in which taxes levied on the various states of the Federal Republic of Germany for discharging wastewater into surface and ground waters can be kept to a minimum are discussed, focusing on ways provided by the law itself. Naturally, it pays to minimize discharges insofar as possible. The Wastewater Tax Law was enacted on January 1, 1981, and the first tax collection was expected in 1982. The law provided for tax exemption in certain cases, including the discharge of polluted water that was already equally polluted when it was taken from its original source, the discharge of polluted water into a surface water if the pollution arises from the washing of raw materials (consists of the raw material degradation products), discharge of rainwater through channels other than the public sewer system, and discharge of wastewaters into groundwater that is unsuitable for use as drinking water. Further provision is made for the nonlevying of tax for a period of three years before the expected startup of a wastewater treatment facility that would reduce the pollution load by at least 20%. Finally, the federal government has the power to waive tax until the end of 1989 if payment would cause 'considerable disadvantageous economic developments' -- as long as efforts are being made to reduce pollution. Some remarks concerning tax collection are given. (Gish-FRC)
W83-02801

FUNDING WATER POLLUTION CONTROL IN SOUTH AFRICA,
Department of Water Affairs, Forestry and Environmental Conservation, Cape Town (South Africa).
J. A. Lusher.
Water Science and Technology, Vol 14, No 9-11, p 1225-1237, 1982. 1 Fig, 6 Tab, 13 Ref.

Descriptors: *Water management, *Economic aspects, *Water pollution control, Water demand, *South Africa, Planning, Management, Decision making.

Water pollution control in South Africa is discussed from the point of view of cost and available sources of revenue. The complexities of interagency interpretation of the word pollution and assessment of the effects of water misuse, as well as how costs are to be borne out of available revenues, inevitably causes confusion in the public mind which is often, unfairly, attributed to bureacratic attitudes. The most that corporate and state responsibility can hope to achieve is to maintain environmental stress at a roughly constant level between technological epochs. The investment by the private sector of physical and human capital for the purposes of profit causes this stress. For this reason the control of pollution by price has been advocated. Water is far too cheap when it is noted that as a human necessity it is far too scarce. It is up to the state to redress the balance by coherent public policy. (Baker-FRC)
W83-02870

THEME 5: WATER POLLUTION CONTROL IN DEVELOPING COUNTRIES: REPORT OF THE SESSION CONVENOR,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
P. H. Jones.
Water Science and Technology, Vol 14, No 9-11, p 1313-1318, 1982.

Descriptors: *Water pollution control, *Water management, *Developing countries, Drinking water, Water supply, Civil engineering.

In order to control water pollution in developing countries it is necessary for the governments of those countries to appoint a water board having responsibility for managing both the water supply and sanitation programs. These countries must also introduce environmental assessment legislation to carefully monitor the introduction of new industries, new developments, and extensions of existing developments including the water supply and sanitation programs themselves, and to evaluate the impacts of these on the environment. These countries must also consider the establishment of effluent standards to control the quality of discharges from new industries and municipal systems, develop a program of training professionals, paraprofessionals and technicians, as well as provide training for decision makers to guide the planning and policy making process. A spectrum of training must be maintained from the trade school level right through to the University level. Various methods must be developed to provide such serv-

ices to deal with the varifying needs of both the scattered communities with little or no organization and the central, congested slums of big cities. (Baker-FRC)
W83-02873

6G. Ecologic Impact Of Water Development

CHANGES IN ABUNDANCE AND GROWTH CHARACTERISTICS OF WHITE PERCH FROM THE MOUTH OF THE BAY OF QUINTE,
Ontario Hydro, Toronto. Research Div.
G. T. Haymes, W. E. Dunford, and G. L. Vascotto.
Journal of Great Lakes Research, Vol 8, No 4, p 614-618, 1982. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Fish harvest, *Environmental effects, *Lake fisheries, *Perch, Fish populations, Fisheries, Bay of Quinte, *Lake Ontario, Commercial fishing, Fishing, Lee's phenomenon, Fish growth, Lennox Generating Station, Powerplants.

White perch populations were sampled in April to November, 1972 through 1978, at three locations near the Lennox Generating Station in the Bay of Quinte. Average approximate monthly catches per 1.2 m trap net for May-July (months of largest catches) were: 175 in 1972, 258 in 1973, 130 in 1974, 155 in 1975, 45 in 1976, 8 in 1977, and < 1 in 1978. Annual commercial catches reached peaks in the range of 200,000-230,000 kg in 1965, 1972, 1976, and 1978. Between these peak periods annual commercial catches were in the 50,000-100,000 kg range. In 1979 the catch dropped sharply to 30,000 kg. Reasons for the low 1979 catch may be a reduction in the total number of gill nets set; the concentration of white perch in the Bay of Quinte mouth in winter, which facilitated commercial netting; and impingement of perch by the generating station intakes starting in 1975. There was a tendency for back-calculated fish lengths at a given age to become progressively smaller as the age of the fish from which they were computed increases (Lee's phenomenon). This may be a result of selective removal of faster growing individuals by commercial fishing. (Cassar-FRC)
W83-02808

INSTREAM FLOW REQUIREMENTS OF NATIVE CALIFORNIA STREAM FISHES,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
P. B. Moyle, D. M. Baltz, and N. J. Knight.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196683, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, April 1983. 24 p, 12 Tab, 6 Ref. OWRT B-210-CAL(1).

Descriptors: *Instream flow, *Fish, Trout, Roach, Sculpin, Sucker, Perch, Velocity, Temperature, Water depth, Temperature effects, Streamflow, Streams, *California, *Fish habitats.

Summaries are presented for two years of microhabitat studies on ten species of California stream fishes: rainbow trout, brown trout, speckled dace, California roach, hardhead, Sacramento squawfish, Lahontan redside, Sacramento sucker, Tahoe sucker, riffle sculpin, Paiute sculpin and tule perch. The measurements of velocity, depth and substrate associated with each species can be used to construct habitat use curves useful for small streams in the Sacramento Valley and in the Truckee drainage. It was found, however, that interactions among species can change microhabitat utilization and that each species has its own set of requirements which may differ somewhat between streams, reflecting both differences in the physical environment and differences in the composition of the fish community. It was also found that temperature has a significant effect on microhabitat utilization. As a consequence of temperature effects, species interactions and unpredictable fluctuations in flow, the relationship between habitat availability and actual use by the fishes in not a strong one. These results imply that if instream flow recommendations are based on the requirements of just one species (usually rainbow trout in California), the populations of other species may change in unpredictable ways. Instream flow recommendations made using 'habitat preference curves' constructed from data collected outside the impact area may not give an accurate picture of the effects of the changed flow regime on rainbow trout or other species. (Snyder-California)
W83-02906

AN ECOLOGICAL STUDY OF OZARK STREAMS,
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
C. F. Rabeni.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-202366, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Missouri, Columbia, March 1983. 81 p, 6 Fig, 6 Tab, 26 Ref, 3 Append. OWRT A-131-MO(1), 14-34-0001-1127 and 2127.

Descriptors: *Streams, *Population dynamics, Secondary production habitat, Ambloplites rupestris, Micropterus dolomieui, Orconectes, Interspecific interactions, Competition, Missouri, Current River, Jacks Fork River, Ecological impact, *Crayfish, Environmental studies.

This research was aimed at quantifying the main pathways of energy flow through an Ozark spring-fed stream. Crayfish (Orconectes spp.) were shown to be the most important invertebrate group in the use of the primary food resources. In turn, crayfish provided the majority of energy for the top predators of the streams: the rock bass (Ambloplites rupestris) and the smallmouth bass (Micropterus dolomieui). The focus was on examining the links among species of crayfish and fish: how they partition their energy supply and their habitat to achieve coexistence. Field sampling and laboratory experiments determined that coexistence of crayfish species was size related and this mechanism for allowing sympatry increased the overall secondary production of the stream. We investigated the mechanisms of rock bass-smallmouth bass interactions with each other and with their food base was investigated. It was concluded that the two species coexist by sharing the abundant food base and partitioning available habitat.
W83-02916

METABOLISM OF CALIFORNIA STREAM FISHES,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 5C.
W83-02944

HYDROLOGIC CHARACTERISTICS OF SURFACE-MINED LAND RECLAIMED BY SLUDGE IRRIGATION, FULTON COUNTY, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5A.
W83-02975

METHODOLOGY FOR HYDROLOGIC EVALUATION OF A POTENTIAL SURFACE MINE: LOBLOLLY BRANCH BASIN, TUSCALOOSA COUNTY, ALABAMA,
Geological Survey, Denver, CO. Water Resources Div.
L. M. Shown, D. G. Frickel, R. F. Miller, and F. A. Branson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-238361, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-50, 1982. 93 p, 12 Fig, 16 Tab, 70 Ref.

Descriptors: *Estimating equations, *Evaluation, *Coal mining, *Land reclamation, Surface water, Groundwater, Water quality, Vegatation, Soil water, Soil porosity, Flow characteristics, Flood peak, Detention reservoirs, Sediment yield, *Alabama, Tuscaloosa County, Warrior Coal Field.

Methodology for evaluation of premining hydrology and postmining effects and reclamation on the hydrology of an area is presented for a potential mine site in northwestern Alabama. Estimation techniques and extrapolation are used to develop data for reconstructed topography, soil-water relations, peak flows, flow volumes, soil losses, and sediment yields. Streamflow response of the basin is described by the variable-source-area concept; nearly all water flows through coarse-textured soils and unconsolidated sand and gravel deposits that are underlain by an impermeable clay zone. The resultant peak discharges are small to moderate, and there is very little erosion of slopes or channels. Susceptibility of the soils to compaction by heavy machines and the effects of compaction on soil-water relations are demonstrated. Estimates of peak discharges made with four methods are divergent, particularly for recurrence intervals of 2, 5, and 10 years; divergence is less for 25-, 50-, and 100-year discharges. A premining estimate of sediment yield made with the Universal Soil Loss Equation and sediment-delivery ratio is about 2.5 times larger than an estimate made with the sediment rating curve-flow duration method. (USGS)
W83-02976

AQUATIC BIOLOGY IN NEDERLO CREEK, SOUTHWESTERN WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
P. A. Kammerer, Jr, R. A. Lidwin, J. W. Mason, and R. P. Narf.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-257577, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-56, November 1982. 27 p, 6 Fig, 10 Tab, 20 Ref.

Descriptors: *Small watersheds, *Water quality, *Ecosytems, *Aquatic life, Benthic fauna, Aquatic plants, Algae, Aquatic insects, Trout, Spawning, Aquatic environment, *Wisconsin, Nederlo Creek, Driftless area.

This report presents the results of biological investigations made during a study of hydrology and water quality in a small drainage basin in the 'Driftless Area' of southwest Wisconsin. The aquatic community is diverse and reasonably stable with little indication of environmental disturbance. Aquatic macrophyte population (dominated by Ranunculus aquatilis L., Veronica catenata Penn., and Nasturtium officinale) varies little from spring to fall. Periphytic and planktonic algae are predominantly diatoms, with the genus Achnanthes dominating both communities. Most genera of planktonic algae originate in the periphyton, but some true planktonic algae were identified. The benthic invertebrate population is dominated by Trichoptera. Biotic index values calculated from benthic invertebrate data indicate that water quality is very good to excellent. The trout population is low and represents only a small part of the total fish population both in biomass and numbers. The most important environmental factors limiting trout population appear to be lack of sufficient cover, insufficient pool depth and volume, and limited spawning areas. The wild trout population is highly dependent on spawning success; when spawning success was poor, populations the following fall were extremely low. (USGS)
W83-02978

EFFECTS OF A FLOODWATER-RETARDING STRUCTURE ON THE HYDROLOGY AND ECOLOGY OF TROUT CREEK IN SOUTHWESTERN WISCONSIN.
Geological Survey, Madison, WI. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161. Geological Survey Water-Resources Investigations 82-23, August 1982. 68 p, 35 Fig, 27 Tab, 67 Ref. (Wentz, D. A., and Graczyk, D. J., Editors).

Descriptors: *Stream discharge, *Floodwater, *Ecology, *Detention reservoirs, Streamflow,

Flood peak, Channel morphology, Bed load, Sedimentation, Trap efficiency, Sediment transport, Sediment yield, Bankfull stage, Flood flow, Channel morphology, Hydraulic geometry, Trout, Aquatic insects, *Wisconsin, Trout Creek, Floodwater-retarding structure.

The primary effect of a floodwater-retarding structure (FRS) on the flow of Trout Creek, Wisconsin is attenuation of flood peaks. Reduction of flood peaks ranged from 58 to 91% during the study period, 1975 to 1979. An inverse relationship exists between sediment concentration and outflow from the FRS during floods. Most sediment stored in the flood pool during floods is released from the reservoir during subsequent reduced discharge. Sediment-trapping efficiency of the FRS was 7% during the 4-year study. The bankfull capacity of the channel was reduced from 154 cubic feet per second upstream from the FRS to 65 cubic feet per second downstream. Mean bankfull depth downstream from the FRS has adjusted to a value 45% less than upstream from the structure due to the sedimentation of materials transported from the FRS during reduced flows. The FRS was not found to have any significant adverse effect on the arthropod fauna or trout reproduction in Trout Creek from 1975 to 1979. During 1960-1979, winter floods seem to have had the greatest adverse effect on the survival of brown trout eggs and sac fry. (USGS)
W83-02985

PRELIMINARY PROJECTIONS OF THE EFFECTS OF CHLORIDE-CONTROL STRUCTURES ON THE QUATERNARY AQUIFER AT GREAT SALT PLAINS, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 5G.
W83-02988

BIOLOGICAL AND RECREATIONAL ASPECTS OF WATER LEVEL MANAGEMENT FOR CLEAR LAKE, IOWA,
Iowa State Univ., Ames. Dept. of Animal Ecology.
W. A. Hubert, J. G. Nickum, D. L. Stang, D. D. McLean, and P. E. Niemeir.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-206839, Price codes: A07 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute Report No 132, January 1983. 139 p, 14 Fig, 42 Tab, 116 Ref. OWRT B-070-IA(1), 14-34-0001-1226.

Descriptors: *Lake, Fish, *Water level stabilization, Fluctuation, Management, *Recreation, *Iowa, Clear Lake, *Aquatic plants, Literature reviews, Surveys.

A literature review and field study were conducted to determine the influence of water level stabilization on biological and recreational aspects of a shallow lake. The aquatic plant community was dominated by emergent species that would be adversely influenced by water level stabilization. The fish community has been influenced by introduction of exotic species and by winterkill. Several species found in Clear Lake have strong habitat associations with aquatic plants. While there is evidence that the elimination of aquatic plants would effect the fish community, it is not possible to predict the manner in which the fish community might change as a result of water level stabilization or reduction in abundance of littoral plants. Recreationists preferred water level stabilization, but it was unlikely that their current perceptions included an understanding of potential impacts on the plant community.
W83-03036

BEHAVIOR OF FISHES IN THE DESAULNIERS RIVER BASIN AFTER FILLING OF THE DESAULNIERS RESERVOIR (COMPORTEMENT DES POISSONS DU BASSIN DE LA RIVIERE DESAULNIERS APRES LE REMPLISSAGE DU RESERVOIR DESAULNIERS),
R. Boucher.
Canadian Water Resources Journal, Vol 7, No 1, p 215-228, 1982. 6 Fig, 12 Ref.

Descriptors: *Fish, *Reservoirs, *Deoxygenation, Water quality, Desaulniers reservoir, James Bay, Lake Desaulniers, Fisheries, Desaulniers river, Fisheries management, Environmental effects, *Canada.

Fish were captured with mesh nets in the lakes and with hoop nets in the rivers feeding into the Desaulniers Reservoir. Before impoundment of the reservoir most of the movements of the fish had been related to spawning. During the first two years of impoundment, the brook trout left the reservoir with the deoxygenation of the water and went upstream, toward the Desaulniers Rivers. The white suckers left the reservoir for the same reason, but moved toward Lake Desaulniers. During the reoxygenation periods the species generally return to the reservoir. During the same years, the small fish (sticklebacks, yellow perches, trout-perches, sculpins) from Lake Desaulniers and the Desaulniers River invaded the reservoir. After these migrations, brook trout changed their feeding habits. An improvement was noted in growth. (Baker-FRC)
W83-03050

ECONOMIC AND ENVIRONMENTAL ISSUES OF THE PROPOSED EXTENSION OF THE WINTER NAVIGATION SEASON AND IMPROVEMENTS ON THE GREAT LAKES-ST. LAWRENCE SEAWAY SYSTEM,
Canada Centre for Inland Waters, Burlington (Ontario).
A. J. Niimi.
Journal of Great Lakes Research, Vol 8, No 3, p 532-549, 1982. 1 Fig, 4 Tab, 41 Ref.

Descriptors: *Environmental effects, *Ice, Cost-benefit analysis, *Great Lakes, *St. Lawrence Seaway, *Canada, Navigation, Wetlands, Economic aspects, Benefits, International agreements.

An expansion of navigation activity on the Great Lakes-St. Lawrence Seaway would not be in the best interest of Canada, according to a study of the cost-benefits and environmental impacts of the project. A 1979 report by the U.S. Army Corps of Engineers proposed extension of the existing 8.5 month navigation season to 11-12 months and/or upgrading facilities to accommodate larger vessels. Total costs of the proposed improvements are difficult to establish. Various government groups and interest groups have produced different economic evaluations. Environmental costs and benefits, such as loss of hydroelectric generating capacity, have not been properly assessed. Some of the expected negative effects associated with navigation during the ice-covered season and with ice control measures are water temperature profile changes, disruption of fish movements, increased turbidity, destruction of ice crossings for large mammals, closing of open-water leads used for feeding and resting by water birds, increased shoreline erosion, and water level fluctuations. Most of the major capital improvements and the environmentally sensitive areas are within Canadian waters. (Cassar-FRC)
W83-03072

STREAM TEMPERATURE UNDER AN INADEQUATE BUFFER STRIP IN THE SOUTHEAST PIEDMONT,
Georgia Univ., Athens. School of Forest Resources.
J. D. Hewlett, and J. C. Fortson.
Water Resources Bulletin, Vol 18, No 6, p 983-988, December, 1982. 5 Fig, 9 Ref.

Descriptors: *Forest watersheds, *Logging, *Water temperature, Buffer zones, Clear-cutting, Forest management, Temperature, Stream degradation, Piedmont, Putnam County, *Georgia, Environmental effects, Watershed management.

The effects of clearcutting loblolly pine on stream water quality were determined in a paired watershed study in Putnam County, Georgia. The control watershed was left in its original state, while the logged area had a partial and irregular buffer strip of 20 ft covering each bank for about 50% of its total length. Water temperatures in the logged watershed in summer were as much as 20 F higher than the control; minimum temperatures in winter were 10 F lower than the control. These observed results did not agree with results from Brown's stream temperature model, which predicted much smaller temperature variations. Results suggest that in areas of gentle land relief even a substantial buffer strip may be insufficient to preserve lower temperatures in shallow groundwater moving toward the stream. (Cassar-FRC)
W83-03149

7. RESOURCES DATA

7A. Network Design

UTILIZATION OF COMPUTERIZED WATER MONITORING AND INFORMATION SYSTEM,
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
E. Ottmann.
Water Science and Technology, Vol 14, No 9-11, p 1540-1544, 1982. 4 Fig.

Descriptors: *Water quality control, *Monitoring, *Computers, Bavaria, Hydrology, Data collection, Stream flow, Data processing, Telemetry, *Federal Republic of Germany.

Computerized water monitoring and information systems may serve several purposes: provide information for special tasks such as modelling prediction of various operations, monitor conditions on overloaded rivers, or inspect the performance of treatment plants and compare this performance with the requirements of state or national laws. The resulting benefits in operation should be set against the costs of installation and the advantage of continuous measurement of parameters. The monitoring network built in Bavaria during the last five years uses a computerized information system that collects data from widely scattered points on rivers and offers evaluated information for users. Control of the automated system is carried out regularly by process computer connected to field stations in Bavaria via dial link lines of the public telephone network and with special parallel-serial codes. Reverse communication is available for remote controlling. (Baker-FRC)
W83-02883

WATER-DATA PROGRAM OF THE U.S. GEOLOGICAL SURVEY,
Geological Survey, Reston, VA. Water Resources Div.
B. K. Gilbert, and T. J. Buchanan.
Available from the Br. of Distr., USGS, 604 S. Pickett St. Alexandria, VA 22304. Geological Survey Circular 863, 1982. 16 p, 6 Fig, 11 Ref.

Descriptors: *Hydrologic data, *Data aquisition, *Data storage and retrieval, Data transmission, Network design, Groundwater, Surface water, Water quality, *U.S. Geological Survey, Quality assurance.

The U.S. Geological Survey is the principal Federal agency responsible for the collection of hydrologic data needed for the planning, development, use, and management of the Nation's water resources. These data are the foundation necessary for conducting analytical and interpretive appraisals describing the occurrence and availability of surface and ground waters, and their physical, chemical, and biological characteristics. The data are likewise required for basic and problem-oriented research in hydraulics, hydrology, and related fields. Hydrologic data collection by the Geological Survey began in 1894. Current operations include about 17,000 stations for collection of river, lake, and reservoir data; about 27,000 wells for collection of ground-water data; and almost 17,000 stations for collection of water-quality information. These activities are described as well as the means by which the data are made available, and how the

program is coordinated with other agencies. (USGS)
W83-02967

DESIGN OF SURFACE-WATER DATA NETWORKS FOR REGIONAL INFORMATION,
Geological Survey, Reston, VA. Water Resources Div.
M. E. Moss, E. J. Gilroy, G. D. Tasker, and M. R. Karlinger.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $4.50. Geological Survey Water-Supply Paper 2178, 1982. 33 p, 12 Fig, 1 Tab, 22 Ref.

Descriptors: *Surface water, *Network design, *Hydrologic data, Regional analysis, Regression analysis, Data collections, Computer programs.

This report describes a technique, Network Analysis of Regional Information (NARI), and the existing computer procedures that have been developed for the specification of the regional information versus cost relation for several statistical parameters of streamflow. The measure of information used is the true standard error of estimate of a regional logarithmic regression. The cost is a function of the number of stations at which hydrologic data are collected and the number of years for which the data is collected. The technique can be used to obtain on a probability basis either (1) a minimum cost network that will attain a prespecified accuracy and reliability or (2) a network that maximizes information given a set of budgetary and time constraints. (USGS)
W83-02970

WATER RESOURCES AND DATA-NETWORK ASSESSMENT OF THE MANASOTA BASIN, MANATEE AND SARASOTA COUNTIES, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. P. Brown.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-156653, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-37, 1982. 80 p, 35 Fig, 10 Tab, 111 Ref.

Descriptors: *Data collections, *Network design, *Water resources development, *Water use, Rainfall, Streamflow, Surface water, Water quality, Groundwater, Aquifers, *Florida, Manasota basin, Manatee County, Sarasota County.

The average annual rainfall in the Manasota Basin is 53.7 inches, and annual evapotranspiration is about 39 inches. Annual runoff from gaged parts of the Basin ranges from about 13 to 17 inches per year. Streamflow in the upland areas diminishes rapidly following the end of the rainy season and approaches zero during extended dry periods. Generally, surface water is of good quality except in tidally affected, coastal areas. Its quality varies seasonally, generally becoming more mineralized during the dry season. The principal hydrogeologic units are the surficial aquifer, the upper confining beds and minor artesian aquifers, the Floridan acquifer, and the lower confining bed. The quality of ground water is generally good except in the western and southern parts where saltwater intrusion or incomplete flushing of residual seawater has occurred. Land-use changes and stream impoundments and diversions require reassessment of the type and use of data collected by the surface-water network. Such changes may require modification of existing sites and establishment of new ones. Development and completion of the monitoring plan could provide most of the data necessary to define the groundwater system. (USGS)
W83-02973

MODERN INFORMATION SYSTEMS FOR WATER SUPPLY COMPANIES-REQUIREMENTS AND FUNCTIONS (MODERNE INFORMATIONSSYSTEME FUR WASSERWARTEN - ANFORDERUNGEN UND FUNKTIONEN),
Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Informations- und Datenverarbeitung.
J. Busser, and H. Lindenberg.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 8, p 351-356, 1981. 6 Fig, 1 Ref.

Descriptors: *Automation, *Water conveyance, *Computers, Water management, Municipal water, Data processing, Water quality data, Hydrologic data, Water supply systems.

The use of small computers and microprocessing units together with standardized software can make computer-controlled operation systems economically practical for small- and medium-sized water supply companies. Basic hardware and software requirements needed for the implementation of a simple system operation, an operational modification and extension service available after the start of operation, and a maintenance service which may be performed in most cases by non-specialists are described. The system, designed especially for companies inexperienced in computer technology, is based on clearly arranged presentation of messages, analog signals, numerical signals, and calculations in alphanumerical and graphical form on displays and printers, as well as comfortable conversational modes. (Author's abstract)
W83-03058

7B. Data Acquisition

CALIBRATION AND FIELD TESTING OF A TWO-PROBE GAMMA GAUGE,
Hebrew Univ., Rehovoth (Israel). Dept. of Soil and Water Sciences.
E. Rawitz, H. Etkin, and A. Hazan.
Soil Science Society of America Journal, Vol 46, No 3, p 461-465, May/June, 1982. 2 Fig, 6 Tab, 10 Ref.

Descriptors: *Soil density, *Calibrations, *Measuring instruments, Density, Soil moisture, *Gamma probe.

A commercial double probe gamma gage for measuring soil moisture and bulk density was calibrated in the laboratory and in field tests in sandy loam loess soils in the Negev region. Laboratory tests showed that the transmitted count rate was affected by the extent of the medium surrounding the beam path, indicating that linearity between log of count rate and sample density is not sufficient proof of monochromatic radiation. It was necessary to use separate attenuation coefficients for soil solids and water. The universal calibration equation for wet density should be used. The calibration stand supplied with the instrument did not produce a calibration curve adequate for field work. Determination of a multipoint calibration curve in the field is necessary. With proper calibration, the gamma probe was able to determine soil density with satisfactory reliability. (Cassar-FRC)
W83-02964

COMPUTER-LINKED CCD CAMERA FOR SEDIMENT SHAPE ANALYSIS,
Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
K. A. Prisbrey, R. E. Rinker, and M. B. Aboukheshem.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-208918, Price codes: A03 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Moscow, March 1983, 28 p, 5 Fig, 2 Tab, 12 Ref, 1 Append. OWRT A-081-IDA(1), 14-34-0001-0216.

Descriptors: *Image processing, Data collection, *Computer Fourier analysis, *Data acquisition, *Camera interfacing, Data interpretation, Sediment shape analysis.

A major problem with using chemical and mineralogical composition analysis to trace stream sediment origins is the cost. A solution to this problem is to use Fourier shape descriptors of individual sediment particles, which gives an inexpensive means of distinguishing sediments even with similar chemical and mineralogical characteristics. A CCD camera was linked to a PDP 11 computer to provide a rapid method of data gathering for such analysis.
W83-03111

SOIL MOISTURE VARIATION PATTERNS OBSERVED IN HAND COUNTY, SOUTH DAKOTA,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2G.
W83-03138

7C. Evaluation, Processing and Publication

PACKAGING OF INFORMATION- PART AND PARCEL OF SUCCESSFUL TECHNOLOGY TRANSFER,
Water Research Commission, Pretoria (South Africa).
M. J. Pieterse.
Water Science and Technology, Vol 14, No 9-11, p 1289-1298, 1982. 23 Ref.

Descriptors: *Technology transfer, *Information exchange, Information systems, Data collections.

For successful technology transfer to occur, the correct packaging of information is needed. Research findings should be tailored and packaged in a format and language that is understandable and acceptable to the user. The transfer should be directed at a target audience, and the principle in the transfer process is simplicity. Various packaging techniques are described; these include mass media techniques such as seminars, conferences, demonstrations and education. The important role of personal contact in a technology transfer program is also stressed. Terminology regarding technology and information transfer is briefly discussed. The availability of the relevant information and the important role of the technology transfer specialist are also briefly examined. (Baker-FRC)
W83-02859

GEOLOGIC AND WELL-CONSTRUCTION DATA FOR THE H-7 BOREHOLE COMPLEX NEAR THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Fenix and Scisson, Inc., Tulsa, OK.
For primary bibliographic entry see Field 4B.
W83-02977

TECHNIQUES FOR ESTIMATING FLOOD DISCHARGES FOR UNREGULATED STREAMS IN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2E.
W83-02981

FLOODS IN MAINE, APRIL-MAY 1979,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 2E.
W83-02983

HYDROLOGIC DATA OF THE LAKE COCHITUATE DRAINAGE BASIN, FRAMINGHAM-NATICK, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
F. B. Gay.
Massachusetts Hydrologic-Data Report No 23, 1981. 61 p, 1 Fig, 1 plate, 16 Tab, 15 Ref.

Descriptors: *Hydrologic data, *Surface runoff, *Nitrogen cycle, *Phosphorus compounds, Potentiometric level, Observation wells, Lakes, Water quality, Groundwater movement, Insecticides, Heavy metals, Chemistry of precipitation, *Massachusetts, Lake Cochituate drainage basin.

This report presents, in tabular form, hydrologic data on the 17.7-square-mile drainage basin above the outlet of Lake Cochituate including parts of Ashland, Framingham, Natick, Sherborn, and Wayland, Massachusetts. These data were collected from July 1977 to July 1979 by the U.S. Geological Survey during a study to describe the inflow and outflow of nutrients in Lake Cochituate. Information in this report includes daily mean discharges and nutrient concentrations for Beaverdam, Course, Pegan, and Snake Brooks (principal streams discharging to Lake Cochituate), and the outlet of Lake Cochituate. It includes instantaneous discharges and nutrient concentrations at 17 storm sewers discharging directly into Lake Cochituate during three rainstorms as well as nutrient concentrations of the wet-atmospheric deposition. It also includes monthly water-level measurements and nutrient concentrations of water from 29 observation wells around Lake Cochituate, selected information on 87 wells and borings, and particle-size distribution of 30 lithologic samples. Many chemical analyses of other constituents associated with the nutrients are also tabulated in this release. (USGS)
W83-02989

HYDROLOGIC DATA OF THE LOWER MERRIMACK RIVER BASIN, MASSACHUSETTS, FROM CONCORD RIVER, LOWELL, TO PLUM ISLAND, NEWBURYPORT,
Geological Survey, Boston, MA. Water Resources Div.
D. F. Delaney, and F. B. Gay.
Massachusetts Hydrologic-Data Report No 24, 1981. 34 p, 1 Plate, 5 Tab, 25 Ref.

Descriptors: *Hydrologic data, *Groundwater, *Text wells, Well longs, Water level, Water table, Chemical analysis, Water quality, *Massachusetts, Lower Merrimack River basin, Borings.

Hydrologic information contained in this report includes physical descriptions of 743 wells, test wells, and borings; logs of materials for 554 of these wells and borings; chemical analysis of water from 51 of these wells compiled from 1972 to 1974; and a list of publications containing water-level records. These data are for all or parts of the cities and towns of Amesbury, Andover, Boxford, Dracut, Groveland, Haverhill, Lawrence, Merrimac, Methuen, Newbury, Newburyport, North Andover, Salisbury, Tewksbury, and West Newbury in Essex and Middlesex Counties. These municipalities are in the lower Merrimack River basin, which drains approximately 180 square miles along the New Hampshire border in northeastern Massachusetts. This area includes parts of the Merrimack River basin within Massachusetts east of the Beaver Brook and Concord River basins except for the Shawsheen River basin. Even though the Blackwater River basin within Massachusetts isn't part of the lower Merrimack River basin, it has been included in this report. (USGS)
W83-02994

DATA FILTERING FOR LARGE AREA ANALYSIS-AN EXAMPLE FROM THE CANADIAN NEARSHORE ZONE OF THE GREAT LAKES,
Canada Centre for Inland Waters, Burlington (Ontario).
D. J. Gregor, and E. D. Ongley.
Journal of Great Lakes Research, Vol 8, No 3, p 470-481, 1982. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Lakes, *Data collections, *Great lakes, Water quality, Spatial distribution, Monitoring, Temporal distribution, Data processing.

A straightforward analysis of the data base compatible with other studies devoted to the assessment of historical Great Lakes basin data is presented. Such a great amount of data is available on the subject that a methodology has been developed to reduce the data set to a manageable size and provide a substantive summary of nearshore water quality for the period 1967-1973. Initially the data can be divided temporally to reflect major changes in laboratory techniques and sampling methodology. Subsequently, the data base is partitioned into geographical regions reflecting sampling station configurations and subjective criteria regarding expected homogeneous water quality. Surface and subsurface data are distinguished among limnologically defined seasons. Descriptive statistics are generated for each cell of the timeframe matrix. One and two-way analysis of variance techniques are used to determine significant statistics for each timeframe matrix. These are assumed to be conservative estimates of average water quality for a given parameter within a particular region and for specified time periods and depths or combinations thereof. Selected water quality data are presented to demonstrate the ability of the method to provide periods of record composite comparisons among water bodies, spatial comparisons within any one time frame and for any selected cell, and temporal trends determined by weighted linear regression for a selected cell through the three timeframes. It was concluded that this data base is useful for evaluating broad spatial and temporal trends and assessing the effect of remedial programs, and warrants more comprehensive anlaysis in conjunction with loadings information and open lake data. (Baker-FRC)
W83-03085

COMPARING METHODS OF HYDROLOGIC REGIONALIZATION,
Geological Survey, Reston, VA.
G. D. Tasker.
Water Resources Bulletin, Vol 18, No 6, p 965-970, December, 1982. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Regional analysis, *Regression analysis, *Model studies, Hydrologic models, Cluster analysis, Data splitting, *Arizona, Gaging stations, Rainfall-runoff relationships.

Data splitting is used to compare methods of determining 'homogeneous' hydrologic regions. The methods compared use cluster analysis based on similarity of hydrologic characteristics or similarity of characteristics of a stream's drainage basin. Data for 221 stations in Arizona are used to show that the methods, which are a modification of DeCoursey's scheme for defining regions, improve the fit of estimation data to the model, but that it is necessary to have an independent measure of predictive accuracy, such as that provided by data splitting, to demonstrate improved predictive accuracy. The methods used the complete linkage algorithm for cluster analysis and computed weighted average estimates of hydrologic characteristics at ungaged sites. (Author's abstract)
W83-03146

AN ENVIRONMENTAL QUALITY INDEX FOR THE GREAT LAKES,
Wisconsin Univ.-Madison. Water Resources Center.
C. E. Steinhart, L. J. Schierow, and W. C. Sonzogni.
Water Resources Bulletin, Vol 18, No 6, p 1025-1031, December, 1982. 1 Fig, 5 Tab, 23 Ref.

Descriptors: *Water quality, *Environmental quality, Lakes, *Great Lakes, Evaluation, Lake restoration.

A new index for summarizing environmental quality was developed for the nearshore waters of the Great Lakes. The index is based on nine physical (P), chemical (C), biological (B), and toxic substance (T) variables. Raw data are converted to subindex values by mathematically defined functions based on national and international objectives. The subindex values are multiplied by weighting factors and addition to give a total score of zero (worst quality) to 100 (highest quality). Subscripts next to the index letters indicate how many of each type of variable were worse than the objectives. For 18 locations in the Great Lakes the index scores ranged from 98 at two stations in Lake Superior to 30 C2P1B2T3 at Point Mouille, Lake Erie. This score is interpreted as: a quality of 30 with deficiencies in 2 chemical, 1 physical, 2 biological, and 3 toxic substance variable. (Cassar-FRC)
W83-03148

8. ENGINEERING WORKS

8A. Structures

RESERVOIR CAPACITY CONSERVATION (CONSERVAZIONE DELLA CAPACITA UTILE NEI LAGHI ARTIFICIALI),
Parma Univ. (Italy).
E. Roveri.
Wasser, Energie, Luft, Vol 73, No 9, p 199-201, September, 1981. 4 Fig, 1 Tab. English summary.

Descriptors: *Artificial lakes, *Reservoir operation, *Sediment discharge, Pipelines, Reservoir silting, Mud, Rendina Lake, *Italy.

The availability of water continues to be a major world-wide problem. Industry and agriculture require increasing amounts of water at low cost, which can only be obtained through the use of artificial reservoirs. However, these reservoirs tend to have a limited lifetime as a result of the suspended solid material carried into them by a streams. The results of application of a new method for cleaning and maintaining reservoirs to artificial lakes in Italy are discussed. The technique involves the use of underwater pipelines to carry the sediments away from the lake. It is possible to control and correct the density and fluidity of the sediments in order to attain a high output without causing detrimental sedimentation downstream. In experiments at Rendina lake in southern Italy, sediments containing a high percentage of sand and clay solids nevertheless were rendered fluid enough to flow easily along the canal downstream from the dam. The primary advantages of the new process are the ability to remove mud quickly, the possibility of using the process on the filled lake, and the ability to disperse the mud downstream. (Carroll-FRC)
W83-02953

SIGNIFICANCE ON THE NEW LARGE WATER RESERVOIR SCHONBUHL AND ITS CONSEQUENCES ON THE LANDESWASSERVERSORGUNG STUTTGART (DIE BEDEUTUNG DES NEUEN GROSSBEHALTERS SCHONBUHL FUR DIE LANDESWASSERVERSORGUNG STUTTGART),
Zweckverband Landeswasserversorgung, Stuttgart (Germany, F.R.).
D. Flinspach.
Wasserwirtschaft, Vol 71, No 3, p 69-73, March, 1981. 6 Fig, 2 Tab, 6 Ref. English summary.

Descriptors: *Water storage, *Reservoir storage, Electric power production, Hydraulic design, Reservoir construction, Reservoir design, Water conveyance, Stuttgart, *Federal Republic of Germany.

The water supply organization 'Landeswasserversorgung Stuttgart,' in West Germany, is constructing a large water storage reservoir with a capacity of 88,000 cubic meters, which is situated 15 kilometers east of Stuttgart. The location of this storage reservoir at the intersection of the three water mains serving an extensive area, its proximity to the main center of consumption, and its size offer novel possibilities for the operation of the long distance water supply system. Efforts of the system's management to maximize procurement, transport, and distribution of water supplies are discussed. Both the construction and the hydraulic lay-out of the reservoir are described. The water storage reservoir will also be connected to an installation for the generation of electric power, which will, together with other such facilities already in operation, enable the Landeswasserversorgung Stuttgart to improve the cost-benefit relationship for electric power. (Author's abstract)
W83-02963

THE FUTURE OF UNDERGROUND PUMPED HYDRO.
International Water Power and Dam Construction, Vol 34, No 12, p 73-75, December, 1982. 2 Fig.

Descriptors: *Pumped storage, *Underground structures, *Hydroelectric plants, Turbines, Pump turbines, Powerplants, Water storage, Reservoirs.

Underground pumped hydro storage (UPH) will become more feasible as soon as reversible pump turbines are developed for operation at 1000-1500 m heads. UPH can be used in flat topography and has minimum environmental impact because one reservoir and the powerhouse are underground. High heads are necessary to minimize the volume of the underground excavation. Disadvantages are the relatively high minimum economic installed capacity (1200-1500 MW), long construction schedule, and high capital costs. A two-stage arrangement is proposed to take advantage of existing turbines. For the Netherlands a design combining UPH with wind power is under study. These findings and other papers were presented at the International Conference on Underground Pumped Hydro and Compressed Air Energy Storage, September 20-22, 1982, San Francisco, California. (Cassar-FRC)
W83-03012

SMALL HYDRO NEEDS ITS OWN EXPERTS.
International Water Power and Dam Construction, Vol 34, No 12, p 69-71, December, 1982. 2 Fig, 3 Ref.

Descriptors: *Hydroelectric plants, *Design criteria, Powerplants, Specifications, Hydraulic structures, Turbines, Settling basins, Generators.

Mini hydro plants cannot be mass produced; each must be designed individually to suit the unique site and conditions. Reference material and experience for small-scale projects is scarce. As a result, poorly designed systems may cause disillusionment with small schemes in general. The intake, the most critical part of the design, must be designed to be easily cleaned or self-cleaned. The most successful settling basins use deep narrow channels, which may be cleaned by draining the pond and allowing the silt to leave through a bywash. Earth-lined canals or wooden flumes made of indigenous timber should always be considered before installing expensive concrete or steel pipes. Penstocks often have an excessive safety factor, which unnecessarily increases costs. Generators should match the turbine output at a head near that of the maximum normal head rather than the rated output. Specifications originally written for large vertical turbines cannot be simply scaled down to apply to small systems, which usually use horizontal turbines and simpler equipment. Specifications should not be unnessarily narrow, so that it will be possible to take advantage of manufacturers' standard items if these are economical. Many powerhouse features necessary in large installations can be eliminated for a small system. (Cassar-FRC)
W83-03013

8B. Hydraulics

SUPPRESSION OF DENSITY WAVES IN CLARIFIERS,
Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
M. C. Murphy, R. R. Hudgins, and P. L. Silveston.
Water Science and Technology, Vol 14, No 9-11, p 1510-1513, 1982. 4 Fig, 3 Ref.

Descriptors: *Density waves, *Clarifiers, *Wastewater treatment, Model studies, Baffles, Fluid mechanics, Mechanical equipment.

Baffles designed to function as wave traps have been shown in experiments to suppress low-frequency, large-amplitude density waves. Experiments were conducted using a 122 cm diameter, circular clarifier with a 1:10 slope from the periphery to the center well. The vessel was dimensionally similar to a full scale center feed, horizontal flow circular clarifier. Simultaneous measurements of solids removal show substantial improvement. The relationship between density waves and the deviation from ideal clarifier performance that earlier papers on internal waves have suggested has been established in this work. The power spectrum of the internal waves and the effect of operating variables such as overflow rate, scraper speed, and suspended solid on the spectrum and solids removal are discussed. (Baker-FR)
W83-02880

TURBULENT VERTICAL MOMENTUM TRANSFER IN STRATIFIED ENVIRONMENTS,
Nevada Univ. System, Las Vegas. Desert Research Inst.
For primary bibliographic entry see Field 2E.
W83-02901

FAST-WATER STREAMS DEFLECTED BY TRANSVERSE WALLS,
University Coll., London (England). Dept. of Civil Engineering.
A. R. Bokaian.
Proceedings of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 73, No 4, p 747-767, December, 1982. 10 Fig, 1 Tab, 22 Ref.

Descriptors: *Flow velocity, *Jets, *Spillways, Hydraulic structures, Hydraulic jump, Hydraulic properties, Flow pattern, Rapid flow, Waves, Supercritical flow, Turbulent flow, Water flow.

Experimental work was carried out to investigate the phenomena associated with a water jet of finite dimensions issuing from an overflow spillway and deflected by a smooth vertical transverse wall which is perpendicular to the initial flow direction. The state of development of the supercritical flow at the toe of the spillway was quasi-potential in most tests. Three disctinct regions of flow were identified. In Region 1, which began at the toe of the spillway, the water depth remained approximately constant apart from a region adjacent to the outlet where a degree of lateral discharge was observed. In Region 2, a hydraulic jump with a lateral discharge was observed. In Region 3, the flow separated from the bed and impinged violently on the wall and became entirely parallel to it, resulting in a complex wave pattern at the wall. Redirection of the flow along the channel center line in Regions 1 and 2 was found to be negligible. In Region 1, the mean flow characteristics were studied in a form relevant to a two-dimensional classical wall jet. The waves at the wall had a pseudo-periodic behavior and their characteristics were studied statistically. (Author's abstract)
W83-03003

CONTEMPORARY STOCHASTIC APPROACH TO WATER RESOURCE SYSTEMS: THE ARMP AND FEATURE PREDICTION MODELS,
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W83-03060

PROOFS OF THE VOLUME AVERAGING THEOREMS FOR MULTIPHASE FLOW,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
J. H. Cushman.
Advances in Water Resources, Vol 5, No 4, p 248-253, 1982. 13 Ref.

Descriptors: *Mathematical equations, *Multiphase flow, Flow, Hydraulics, Fluid mechanics.

Formal rigorous proofs are presented for the volume averaging theorems of multiphase flow. The proofs are the first that are conceptually elementary and yet mathematically rigorous. The proofs as presented hold for a n-dimensional system and may be generalized to hold for a differentiable manifold. The motivation for presenting distributional proofs of the volume averaging theorems was twofold: first, a particular function is on the microscopic scale and may experience jump discontinuities between phases. This implies that the differential equations governing the microscopic flows should be thought of as distributional where a distribution given by a locally integrable function is defined. Secondly, all prior proofs of these theorems have been somewhat heuristic and in some cases contain errors. The proofs as presented lay the sound mathematical base needed for a proper understanding of multiphase flow phenomena. (Baker-FRC)
W83-03063

8C. Hydraulic Machinery

DAM AND RIVER SAND-DRIFTING INSPECTION (LA BATHYMETRIE--TECHNIQUE DE SURVEILLANCE DE L'ENSABLEMENT DES FLEUVES ET DES RETENUES),
Travaux Sous-Marins, Peney (Switzerland).
For primary bibliographic entry see Field 2J.
W83-02961

DEVELOPMENT POTENTIAL FOR LOW-HEAD HYDRO,
Shawinigan Engineering Co. Ltd., Montreal (Quebec). Hydro-Electric Div.
R. Nair.
International Water Power and Dam Construction, Vol 34, No 12, p 49-56, 72, December, 1982. 8 Fig, 2 Tab, 13 Ref.

Descriptors: *Electrical equipment, *Hydroelectric power, *Turbines, Design criteria, Generators, Electric power production, Hydraulic machiner, Inverters.

Variable speed operation of hydraulic propeller turbines in a low head hydroelectric scheme has several advantages compared with constant speed turbines. It allows greater flexibility in equipment design and application to a wide variety of site requirements. Water hammers caused by speed governing are eliminated. Self-commutated inverters, more expensive than line-commutated inverters, are well-suited to small hydro schemes because they have good inherent voltage regulation and the ability to handle wide variations in load magnitude, power factor, and frequency. They have high efficiency and small size. Disadvantages of variable speed operation are the need to vary the number of units in service to obtain constant flow and low efficiency at partial loads. Inertia requirements and the speed governor may be eliminated in many variable speed units. Kaplan control is often not needed in bulb units. (Cassar-FRC)
W83-03005

SMALL PUMP-TURBINES TO SUPPLEMENT GRID CAPACITY,
McGraw-Edison Co., Mountainside, NJ.
L. Schafer.
International Water Power and Dam Construction, Vol 34, No 12, p 38-40, December, 1982. 2 Fig, 1 Tab.

Descriptors: *Turbines, *Electrical equipment, *Generators, Pump turbines, Hydraulic machinery, Hydroelectric power.

For most small hydropower applications an induction generator is more suitable than a synchronous generator. Induction generators are simpler to operate and are less expensive to operate at smaller sizes (below 1250 kW). They also need less switchgear equipment. However, synchronous generators are more suitable for isolated operation. They have higher efficiencies and can contribute to the maintenance of system voltage and power factor. (Cassar-FRC)
W83-03006

INSTALLED AND PLANNED MINI HYDRO,
Kossler G.m.b.H., St. Polten-St. Georgen (Austria).
E. Kossler.
International Water Power and Dam Construction, Vol 34, No 12, p 35-38, December, 1982. 8 Fig.

Descriptors: *Turbines, *Hydroelectric plants, Hydraulic machinery, Hydraulic structures.

Several small hydro plants built in small European communities are described. At Balavaus, Switzerland, pressure in the drinking water conduit has

been converted to more than 20 million kWh since the plant's commissioning 10 years ago. The Kropfitsch, Austria, plant, relocated in 1980, uses a double-jet impulse turbine. A four-jet impulse turbine was installed in 1977 during modernization of the Graubunden, Switzerland, plant. Output of the Stalvedro plant at Bivio, Switzerland, was tripled by replacing a large Francis spiral turbine (200 kW) with two compact turbogenerators (500 kW each). The Manegg station, Zurich, Switzerland, was updated without changing the existing buildings by using two existing turbine intakes and the tailwater chamber for two new vertical Kaplan tube turbines. Increasing demand at Taubinger's private power station led to addition of a new plant featuring an S-tube turbine, which operates a high efficiency even at small discharges. In Bamberg, Germany, an underground power station and a 2500 kW heat pump are being built so that the modern construction does not detract from the historical mill quarters being restored. (Cassar-FRC)
W83-03007

ENERGY FOR RURAL DEVELOPMENT,
Intermediate Technology Industrial Services, Rugby (England).
R. Holland.
International Water Power and Dam Construction, Vol 34, No 12, p 29-32, December, 1982. 4 Fig.

Descriptors: *Hydroelectric plants, *Developing countries, *Turbines, Hydraulic machinery, Rural areas, Dormilon River, Columbia, Sri Lanka, Control systems, Water wheels, Powerplants, Electric power production, Pelton wheels.

Micro hydropower is a more effective choice for rural electrification than grid extension, especially in developing countries. A guaranteed industrial user for the power produced by a system helps ensure the success of a micro hydro project. Electronic load control has also been an integral part of several projects. A sawmill was built in connection with the hydroelectric system built on the Dormilon River, Columbia. River water is diverted to a 6 kW four-jet direct drive Pelton wheel governed by the electronic load control to accept whatever flow is available (design flow, 55 liters per sec). In Sri Lanka hundreds of private micro hydro plants on tea estates have fallen into disuse. Two renovation projects are described in which Francis turbine-generator sets in poor condition are being replaced with vertical axis four-jet Pelton wheels. Power produced by these plants is expected to supply complete power requirements for the tea processing machines in the wetter months. (Cassar-FRC)
W83-03008

8D. Soil Mechanics

SAFETY FACTORS FOR PROBABILISTIC SLOPE DESIGN,
Worcester Polytechnic Inst., MA.
R. A. D'Andrea, and D. A. Sangrey.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No 9, p 1101-1118, September, 1982. 7 Fig, 7 Tab, 42 Ref.

Descriptors: *Slope stability, *Slope protection, Model studies, *Safety, *Sensitivity analysis, *Design criteria, Slopes, Soil Conservation, Slope degradation, Slope stabilization, Statistical analysis, Mathematical studies, Probabilistic process.

Some inconsistencies in the present methodology for solving slope stability problems under undrained conditions are noted. To handle these differences, a first-order, second-moment model based on probability is suggested for safe slope design. The technique incorporates these problems as separate variables and uses partial safety factors that are proportional to the coefficient of variation of the pertinent parameters. A circular arc failure mechanism is assumed, and the adequacy of the design is based on the derived value of a reliability measure, the safety index. This index reflects the probability of occurrence of the assumed failure mechanism. Statistical data for the required load, resistance factors, and stochastic bias factors that contribute to resistance are given. This information may be used to calculate the safety index associated with current design techniques. Sensitivity studies to determine which variables have the greatest effect on design are also presented. Partial safety factors are proposed for designs corresponding to a desired failure probability. (Geiger-FRC)
W83-03090

8E. Rock Mechanics and Geology

PRECAUTION MEASURES AGAINST UPLIFT AND SEEPAGE EFFECTS ON GIGERWALD ARCH-DAM (MESURES DE PROTECTION CONTRE LES EFFECTS DE LA SOUS-PRESSION ET DES INFILTRATIONS AU BARRAGE-VOUTE DE GIGERWALD),
Bureau d'Ingenieurs-Conseils, Lausanne (Switzerland).
E. Schnitzler.
Wasser, Energie, Luft, Vol 73, No 4, p 65-70, April, 1981. 9 Fig, 1 Tab, 1 Ref. English Summary.

Descriptors: *Arch dams, *Dam construction, *Uplift pressure, Dam foundations, Dam stability, Controlled drainage, Seepage control, Stress, Geologic fractures, Rock mechanics, Gigerwald Dam, *Switzerland.

The arch-dam at Gigerwald, Switzerland, which is 147 meters high, rests on partially fissured rock on its left bank. A variety of measures have been employed to reduce the negative effects of uplift pressure and seepage at the dam. These measures include deepening of the foundation to achieve better embedding in the rock; stability checking of the rocky abutment under more severe conditions; observation of the rock movements during construction; drilling of drainage boreholes in order to reduce the effects of uplift pressure and seepage; and use of proper observations of stress and discharge of seepage to check the efficiency of the precautionary measures. The drainage arrangement dimished the uplift pressure on the foundation, which apparently halted the spread of fissuration in one of the planes of fissuration. (Carroll-FRC)
W83-02960

8F. Concrete

LOSSES OF WATER AND UNDERPRESSURES AT THE DIXENCE DAM (PERTES D'EAU ET SOUS-PRESSIONS AU BARRAGE DE LA GRANDE DIXENCE),
Grande Dixence Societe Anonyme, Sion (Switzerland).
J. Torrione.
Wasser, Energie, Luft, Vol 73, No 4, p 78-82, April, 1981. 7 Fig, 2 Tab. English summary.

Descriptors: Dams, *Water pressure, *Water loss, Leakage, Dam foundations, Artificial lakes, Grand Dixence, *Switzerland.

The lake created by the dam at Grande Dixence, Switzerland, was first filled in the autumn of 1966. Leakages from the lake during this first filling were particularly concentrated on the left shore. Two series of injections of cement were used to reduce the leakage from 27 to 8 liters per second. The first series involved injection of 80 tons of cement into borings 15 meters long. The second series involved injection of 30 tons of cement into borings 17 and 60 meters long. Of the 16 devices used to measure the pressure at the level of the dam foundations, only three are still functioning. The highest pressure coefficient at the foundations now varies around 40%. Twenty manometers are used to measure the pressure of the percolating water in the galleries and pits. The pressures there are very high, sometimes reaching 100%, which is normal, since the measurements are made upstream from the dam and veil. However, the run-offs are insignificant. (Carroll-FRC)
W83-02962

8G. Materials

RIVER AND WATERCOURSE CROSSINGS AND LAKE OUTLETS WITH HDPE PIPES (FLUSS- UND GEWASSERKREUZUNGEN SOWIE SEEAUSLAUFLEITUNGEN MIT ROHREN AUS HDPE),
Europlast Rohrwerk G.m.b.H., Oberhausen (Germany, F.R.). Technische Beratung und Projektierung.
H. Bromstrup, and T. Schramm.
Wasser, Energie, Luft, Vol 73, No 1/2, p 1-5, January/February, 1981. 8 Fig, 5 Ref. (No English Summary).

Descriptors: *Pipes, *Construction materials, *Plastics, *Outlets, *Water conveyance, Underwater pipes, Conveyance structures, Hard polyethylene, Construction methods, Pipe manufacture, Pipe construction, Water pressure, Water transport, Conduits.

The use of hard polyethylene (HDPE) in the construction of pipes for conduits running under waterways and for outlets into lakes or oceans is discussed, and the manufacture and laying of such pipes is described. HDPE pipes can be manufactured in seamless extruded fixed lengths, obviating the need for welding joints at the laying site; they are light and easy to handle; their flexibility makes laying easier -- they usually conform to the shape of the river bed; they are resistant to corrosion and aging; and they are chemically stable, so are not affected by substances found for example in wastewaters. Underwater conduits can be either pressure pipes (used to carry drinking, cooling, or wastewater) or nonpressure pipes (for cables); wall thickness for the former is determined by interior pressure or by the load exerted outside and for nonpressure pipes by external load alone. Equations are given to calculate buckling pressure for an undistorted pipe lying on the river bed and for a distorted pipe embedded in the river floor, as well as for the safety factor against buckling. Pipes with a diameter of up to 160 mm can be wound onto drums and transported by truck; longer and larger pipes are carried by rail or water. Uplift during pipe laying is counteracted by ballast. Three laying methods are described: dragging the pipe through a dredged channel by a pulley on the bank; positioning the pipe above its destination and sinking it, using weights; and unwinding it from a boat into an underwater tunnel. (Gish-FRC)
W83-02803

CHANNEL DESIGN TO MINIMIZE LINING MATERIAL COSTS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
T. J. Trout.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No 4, p 242-249, December, 1982. 4 Fig.

Descriptors: *Linings, *Channel morphology, *Cost analysis, Open channels, Construction costs, Design criteria, Cross-sections.

A direct algebraic and graphical solution was developed to calculate the design of lined trapezoidal channels to minimize lining material costs when costs of bed and side linings are different. The method can also be used to calculate costs added as a result of deviating from optimal designs. Moderate deviations from optimal designs do not usually increase costs significantly. (Cassar-FRC)
W83-02837

CORROSION BEHAVIOR OF PASSIVATABLE STAINLESS STEEL UNDER REDUCING CONDITIONS WITH SIMULTANEOUS ABRASIVE STRESS (DAS KORROSIONSVERHALTEN PASSIVIERBARER NICHTROSTENDER STAHLE IN WASSERN UNTER REDUZIERENDEN BEDINGUNGEN BEI GLEICHZEITIGER ABRASIVER BEANSPRUCHUNG),
Mannesmann-Forschungsinstitut G.m.b.H., Duisburg (Germany, F.R.).
G. Herbsleb.

Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 7, p 343-355, July, 1982. 14 Fig, 2 Tab, 25 Ref.

Descriptors: *Corrosion control, *Pipes, Oxidation, Chemical reactions, Stainless steel, Oxidation-reduction potential.

Corrosion resistant properties of 18-10 chromium-nickel stainless steel have been investigated. These studies show that this steel maintains its corrosion resistant properties in aqueous sodium chloride solutions (35 to 35,000 ppm chloride) at potentials more negative than the pitting potential even when the following conditions are present: cathodic polarization (U(H)=-0.2 V); acidification to a pH of 3.9; the presence of chemical compounds which stimulate pitting, such as sodium sulfide bubbling with hydrogen sulfide; increased temperature up to 80C; abrasion; and flow rates up to 0.27 meters per second. The oxidizing capacity of water was found to be sufficently high to maintain the passive state at potentials more negative than the pitting even when these detrimental factors were present. (Author's abstract)
W83-03047

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

FUNDING WATER POLLUTION RESEARCH,
Texas Univ. at Austin. Dept. of Civil Engineering.
G. A. Rohlich.
Water Science and Technology, Vol 14, No 9-11, p 1239-1243, 1982. 3 Tab, 10 Ref.

Descriptors: *Water pollution control, *Economic aspects, Planning, Economic evaluation, Water quality, *Financing, Federal support.

Unprecedented activity has been noticed during the past decade resulting from public awareness and concern about the quality of the environment. Because pollution problems cut across categorically defined media boundaries, it is difficult to determine the total expenditures for water pollution research. A reasonable estimate can be made of the funding specifically allocated for water pollution research, but this estimate is somewhat less than the total research effort. The total national research expenditures increased from about $13.5 billion to $25.9 billion in each of the past two decades. Although the expenditures in 1979 were more than double those in 1970, in constant dollars virtually no growth occurred. The percentage contributed by the Federal government has decreased over the years. The National Science Foundation report divides the expenditures into three categories: basic research, applied research and development. Estimates for the annual outlays for water pollution control are tabulated for the years 1969 and 1979. As shown, there has been an 8-fold increase in the total annual costs for water pollution abatement expenditures. The EPA is the major federal agency conducting research in this area, and its responsibilities continue to increase as additional environmental legislation is enacted. Budget constraints at all government levels will require more reliance on funding from the private sector, particularly for the basic research. (Baker-FRC)
W83-02871

10. SCIENTIFIC AND TECHNICAL INFORMATION

10F. Preparation Of Reviews

SEDIMENT TRANSPORT IN ALLUVIAL CHANNELS: RATES FOR EROSION AND DEPOSITION OF COHESIVE SEDIMENTS LITERATURE REVIEW AND EXPERIMENTAL DESIGN,
Oklahoma State Univ., Stillwater. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2J.
W83-03032

SUBJECT INDEX

ACID MINE DRAINAGE
Some Chemical Characteristics of Mine Drainage in Illinois,
W83-02971 5B

Metabolic Properties of Thiobacillus ferrooxidans Isolated from Neutral pH Mine Drainage,
W83-03045 5B

ACID PRECIPITATION
Effect of Atmospheric Sulfur Pollutants Derived from Acid Precipitation on the Benthic Dynamics of Lakes,
W83-03093 5C

An Assessment of the Economic Magnitude of Environmental Damage From Acid Precipitation in the Adirondacks,
W83-03095 6B

ACID RAIN
Metal Input and Mobilization in Two Acid-Stressed Lake Watersheds in Maine,
W83-02891 5B

Nature and Extent of Acid Snowpacks in Pennsylvania,
W83-02943 2C

Nutrients and Acid in Rain and Dry Fallout at Fayetteville, Arkansas (1980-1982),
W83-03041 2K

ACIDITY
Chemistry of South Polar Snow,
W83-03119 2K

ACTIVATED CARBON
Effect of Ozonation on the Biodegradability and Adsorbability of Specific Organics to be Removed in the 'Biologically Activated Carbon (BAC)' Process,
W83-03107 5D

Granular Activated Carbon and Preozonated Granular Activated Carbon Treatment for Biologically and Physically-Chemically Treated Wastewater Effluents,
W83-03128 5D

ACTIVATED SLUDGE
Automation Study of Activated Sludge Processes,
W83-02909 5D

Laboratory Study of Dynamic-State Control of Activated Sludge Processes,
W83-02910 5D

ACTIVATED SLUDGE PROCESS
Team Effort Solves Operational Problems,
W83-02805 5D

Mechanism of Clarification Failure,
W83-02807 5D

The Effect of Aeration Basin Configuration on Activated Sludge Bulking at Low Organic Loading,
W83-03120 5D

ADIRONDACK MOUNTAINS
An Assessment of the Economic Magnitude of Environmental Damage From Acid Precipitation in the Adirondacks,
W83-03095 6B

ADIRONDACKS
Effect of Atmospheric Sulfur Pollutants Derived from Acid Precipitation on the Benthic Dynamics of Lakes,
W83-03093 5C

ADMINISTRATION
Legal and Administrative Control Aspects of Oil Pollution,
W83-02868 5G

Legal and Administrative Aspects,
W83-02874 5G

ADSORPTION
Water and Wastewater Treatment With Reusable Magnetite Particles,
W83-02852 5D

Improving Design of a Domestic Waste Disposal System Using an Unsaturated Flow Model and Phosphorus Adsorption,
W83-02900 5D

Radium, Thorium and Radioactive Lead Isotopes in Groundwaters: Application to the in Situ Determination of Adsorption-Desorption Rate Constants and Retardation Factors,
W83-02937 2K

The Influence of Adsorption on Glass, pH and Temperature on the Disappearance of Permethrin in Aqueous Systems,
W83-03057 5B

ADVECTION
Test of an Equation for Evaporation From Bare Soil,
W83-02929 2G

AERATION
Water and Air Renewal in Reservoirs (Les Reservoirs D'eau Potable. 1-Le Renouvellement Methodique de L'eau et de L'air Dans les Reservoirs),
W83-02815 5G

Volatilization of Organic Trace Contaminants by Air Stripping for Water Reclamation,
W83-02917 5D

AERATION BASINS
The Effect of Aeration Basin Configuration on Activated Sludge Bulking at Low Organic Loading,
W83-03120 5D

AEROBIC DIGESTION
Mortality Patterns of Indicator Organisms During Aerobic Digestion,
W83-02834 5E

AEROSOLS
Microbiological Aerosols From a Field-Source Wastewater Irrigation System,
W83-02835 5B

AFRICA
Possible Influences Upon Lake Development in the East African Rift Valleys,
W83-03115 2H

AGGRADATION
Effects of Aggradation and Degradation on Riffle-Pool Morphology in Natural Gravel Channels, Northwestern California,
W83-02936 2J

AGRICULTURAL RUNOFF
Pollution of Ground Waters by Chlorocholine Chloride Used in Agriculture (Voprosy Zagryazneniya Gruntovykh Vod Pri Primenenii Khlorkholinkhlorida V Selyskom Khozyaistve),
W83-03011 5B

Transport Modeling of an Agricultural Pesticide, Phase I,
W83-03043 5B

AGRICULTURE
Agricultural Vs. Hydropower Tradeoffs in the Operation of the High Aswan Dam,
W83-02934 6B

Hygienic Evaluation of Water Polluted by Pesticides Entering Water Bodies in Surface Runoff (Gigienicheskaya Otsenka Vody, Zagryaznennoi Nekotorymi Pestitsidami Pri Postuplenii Ikh V Vodoem S Poverkhnostnym Stokom),
W83-03017 5C

ALABAMA
Methodology for Hydrologic Evaluation of a Potential Surface Mine: Loblolly Branch Basin, Tuscaloosa County, Alabama,
W83-02976 6G

ALASKA
Metabolic Properties of Thiobacillus ferrooxidans Isolated from Neutral pH Mine Drainage,
W83-03045 5B

Mobilization, Movement and Deposition of Active Subaerial Sediment Flows, Matanuska Glacier, Alaska,
W83-03116 2J

ALGAE
Coagulation and Removal of Algal Suspensions From Wastewater Stabilization Ponds,
W83-02903 5D

ALGAL GROWTH
Research Into the Mass Culture of Algae in Closed Systems,
W83-02854 5D

ALGAL POPULATION TRENDS
Coagulation and Removal of Algal Suspensions From Wastewater Stabilization Ponds,
W83-02903 5D

ALGICIDES
An in Situ Comparison of the Effectiveness of Four Algicides,
W83-03137 5D

ALKALINE WATER
An in Situ Comparison of the Effectiveness of Four Algicides,
W83-03137 5D

ALLUVIAL AQUIFERS
Delineation and Hydrologic Effects of a Gasoline Leak at Stovepipe Wells Hotel, Death Valley National Monument, California,
W83-02982 5B

ALUM
Alum Control of Internal Phosphorus Loading in a Shallow Lake,
W83-03140 5G

ALUMINUM
Effect of Solution Chemistry on Coagulation with Hydrolyzed Al(III): Significance of Sulfate Ion and pH,
W83-02949 5F

AMES ASSAY
Artifacts and Losses in the Sampling of Chlorinated Waters by XAD Adsorption,
W83-03104 5A

AMMONIA
Evaluation of EPA Un-Ionized Ammonia Toxicity Criteria,
W83-03091 5G

ANAEROBIC CONDITIONS
Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Water with the Aid of Incubation Experiments. Part 1: Determination of Rates of Phosphorus and Iron Release (Bestimmung von Nahrstoff- und Metall-Freisetzungsraten aus Sedimenten Umweltbelasteter Fliessgewasserstauhaltungen mit Hilfe von Inkubationsversuchen. Teil 1: Bestimmung von Phosphor- und Eisenfreisetzungsraten),
W83-03053 5B

An Integrated Low Cost System for Treatment of Potato Processing Wasterwater Incorporating

ANAEROBIC CONDITIONS

Anaerobic Fermentation and Phosphorus Removal,
W83-03124 5D

ANAEROBIC DIGESTION
Thermal Pretreatment of Sludges--A Field Demonstration,
W83-02831 5E

Response of Methane Fermentation Systems to Industrial Toxicants,
W83-02833 5D

Inhibition Modeling In Anaerobic Digestion,
W83-03126 5D

ANIMAL WASTES
Pollution Potential Ranking of Barnyards for Priority Watershed Planning,
W83-02915 5G

ANTARCTIC
Chemistry of South Polar Snow,
W83-03119 2K

APPARENT MOLECULAR WEIGHT
Seasonal Patterns and Molecular Weight Variations of Trihalomethane Precursors and Trihalomethane Forming Potential in the Kaw Reservoir,
W83-03108 5B

AQUACULTURE
Effects of Water Exchange on Water Quality in Channel Catfish Ponds,
W83-02897 5G

AQUATIC BACTERIA
Atypical Mycobacteria Isolated at Catania (Microbatteri Atipici Isolati a Catania),
W83-03009 5A

AQUATIC BIOLOGICAL COMMUNITIES
Statistics of Species Abundance Distributions in Monitoring Aquatic Communities,
W83-03035 5C

AQUATIC ENVIRONMENT
Statistics of Species Abundance Distributions in Monitoring Aquatic Communities,
W83-03035 5C

AQUATIC LIFE
Aquatic Biology in Nederlo Creek, Southwestern Wisconsin,
W83-02978 6G

AQUATIC PLANTS
Biological and Recreational Aspects of Water Level Management for Clear Lake, Iowa,
W83-03036 6G

AQUATIC POPULATIONS
Statistics of Species Abundance Distributions in Monitoring Aquatic Communities,
W83-03035 5C

AQUATIC WEED CONTROL
Reproductively Limited Grass Carp for Biological Control of Aquatic Weeds--Broodstock Production and Testing,
W83-02898 4A

AQUIFER CHARACTERISTICS
Geology and Ground-Water Resources of Oswego County, New York,
W83-02987 2F

Ground-Water Resources of the Arcadia-Minden Area, Louisiana,
W83-02991 2F

AQUIFER PARAMETER
Aquifer Parameter Prediction by Numerical Modeling,
W83-02912 2F

AQUIFER RECHARGE
Well Recharge in Idealized Rectangular Aquifers,
W83-03056 4B

AQUIFER TESTING
Aquifer Test Results, Green Swamp Area, Florida,
W83-02980 2F

AQUIFERS
Is the Ogallala Going Dry.
W83-02839 3F

Derivation of Vertically Averaged Equations Describing Multiphase Flow in Porous Media,
W83-02930 2F

ARCH DAMS
Precaution Measures Against Uplift and Seepage Effects on Gigerwald Arch-Dam (Mesures De Protection Contre Les Effects De La Sous-Pression et Des Infiltrations Au Barrage-Voute De Gigerwald),
W83-02960 8E

ARID LANDS
Field Tests Underwqy for Three New Agricultural Polymers.
W83-03129 3F

ARID ZONES
Sedimentation and its Control in Nadis in the Indian Arid Zone - a Case Study,
W83-03133 2J

ARIZONA
Price, Socioeconomic, and Climatic Influences on Residential Water Use in Southern Arizona,
W83-02894 6D

Hydrological and Environmental Controls on Water Management in Semiarid Urban Areas -- Phase II,
W83-02918 4D

Evapotranspiration Before and After Clearing Phreatophytes, Gila River Flood Plain, Graham County, Arizona,
W83-02966 2D

Comparing Methods of Hydrologic Regionalization,
W83-03146 7C

ARKANSAS
Nutrients and Acid in Rain and Dry Fallout at Fayetteville, Arkansas (1980-1982),
W83-03041 2K

ARKANSAS RIVER
The Effects of pH and Redox Potential on the Release of Heavy Metals From Arkansas River Sediments,
W83-03112 5B

ARSENIC
Metabolic Properties of Thiobacillus ferrooxidans Isolated from Neutral pH Mine Drainage,
W83-03045 5B

ARTIFICIAL LAKES
Reservoir Capacity Conservation (Conservazione Della Capacita Utile Nei Laghi Artificiali),
W83-02953 8A

ASWAN DAM
Agricultural Vs. Hydropower Tradeoffs in the Operation of the High Aswan Dam,
W83-02934 6B

ATHEROSCLEROSIS
The Relationship of Minerals Commonly Found in Drinking Water to Atherosclerosis and Hypertension in Pigeons,
W83-03081 5C

ATLANTIC COAST
Sources, Sinks, and Storage of River Sediment in the Atlantic Drainage of the United States,
W83-03117 2J

ATMOSPHERIC DEPOSITION
Nature and Extent of Acid Snowpacks in Pennsylvania,
W83-02943 2C

Nutrients and Acid in Rain and Dry Fallout at Fayetteville, Arkansas (1980-1982),
W83-03041 2K

ATRAZINE
Transport Modeling of an Agricultural Pesticide, Phase I,
W83-03043 5B

AUTOMATION
Telecontrol and the Computer in Water Supply (Telesurveillance Et Ordinateur Au Service Des Eaux),
W83-02846 5F

Automation Study of Activated Sludge Processes,
W83-02909 5D

Modern Information Systems for Water Supply Companies-Requirements and Functions (Moderne Informationssysteme Fur Wasserwarten - Anforderungen Und Funktionen),
W83-03058 7A

BACTERIA
Mortality Patterns of Indicator Organisms During Aerobic Digestion,
W83-02834 5E

Sanitary Problems in Relationship With Tap Water Distributed in New or Recent Buildings of Paris (Problems Sanitaires Poses A Paris Par L'Eau Potable Dans Les Immeubles Neufs Ou Recents),
W83-02844 5F

The Survival of Bacterial Indicators in Lysimeters and Landfills,
W83-02886 5E

Bacterial Utilization of Simple Alcohols and Their Influence on Saturated Hydraulic Conductivity,
W83-03014 2G

Drinking Water and Legionnaires' Disease,
W83-03067 5F

Elements of the Inhibition of Nitrifying Bacteria,
W83-03127 5D

BACTERIAL POPULATION TRENDS
Coagulation and Removal of Algal Suspensions From Wastewater Stabilization Ponds,
W83-02903 5D

BANK EROSION
Erosion of Banks Along Piedmont Urban Streams,
W83-02945 2J

BARN WASTES
Pollution Potential Ranking of Barnyards for Priority Watershed Planning,
W83-02915 5G

BASS
The Striped Bass Decline in the San Francisco Bay-Delta Estuary,
W83-02919 5C

BATHYMETRY
Dam and River Sand-Drifting Inspection (La Bathymetrie--Technique De Surveillance De L'Ensablement Des Fleuves Et Des Retenues),
W83-02961 2J

BED LOAD YIELD
A Study of the Bed-Load Yield From a Watershed,
W83-03096 2J

BENEFITS
The National Recreational Fishing Benefits of Water Pollution Control,
W83-03130 6B

Benefits of Pollution Control on Massachusetts' Housatonic River: A Hedonic Pricing Approach,
W83-03141 6B

BENTHIC FAUNA
Vertical Distribution of Profundal Benthos in Lake Superior Sediments,
W83-02822 2H

Retention of Benthic Invertebrates With Different Sieving Techniques,
W83-02825 2H

BENTHOS
Effect of Atmospheric Sulfur Pollutants Derived from Acid Precipitation on the Benthic Dynamics of Lakes,
W83-03093 5C

BIOASSAY
Toxicity Assessment of Snowmelt Water Runoff in an Urban Area (Toxicite Des Eaux De Ruissellement De La Fonte De Neige En Milieu Urbain),
W83-02958 5C

BIOCONTROL
Reproductively Limited Grass Carp for Biological Control of Aquatic Weeds--Broodstock Production and Testing,
W83-02898 4A

BIODEGRADATION
Effect of Ozonation on the Biodegradability and Adsorbability of Specific Organics to be Removed in the 'Biologically Activated Carbon (BAC)' Process,
W83-03107 5D

BIOINDICATORS
Exposure to Microbial Aerosols From Activated Sludge Treatment,
W83-03097 5D

BIOLOGICAL DEGRADATION
Computer Control in a Biological Sewage Plant, Methods and Experience,
W83-02851 5D

BIOLOGICAL TREATMENT
Effect of Ozonation on the Biodegradability and Adsorbability of Specific Organics to be Removed in the 'Biologically Activated Carbon (BAC)' Process,
W83-03107 5D

BIOPORES
Water Diffusivity of a Field Soil,
W83-02995 2G

BLOCK RATE PRICE SCHDULES
Price, Socioeconomic, and Climatic Influences on Residential Water Use in Southern Arizona,
W83-02894 6D

BOREHOLES
Geologic and Well-Construction Data for the H-7 Borehole Complex Near the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-02977 4B

BORON
Salinity and Boron Control Under High-Frequency Low-Volume Irrigation,
W83-02908 5B

BOTTOM SEDIMENTS
Retention of Benthic Invertebrates With Different Sieving Techniques,
W83-02825 2H

Waste From the Water Treatment Plant at Alton and Its Impact on the Mississippi River,
W83-02920 5E

BOTTOMM SEDIMENTS
Dam and River Sand-Drifting Inspection (La Bathymetrie--Technique De Surveillance De L'Ensablement Des Fleuves Et Des Retenues),
W83-02961 2J

BRAZIL
Costs for Supplying Alternative Community Water and Sanitation Systems in Brazil,
W83-03092 6C

BREAKPOINT CHLORINATION
A Theoretical and Experimental Investigation of the Dynamics of Breakpoint Chlorination in Dispersed Flow Reactors,
W83-02926 5F

BRINE DISPOSAL
Water Quality Modeling of the Equus beds Aquifer in South Central Kansas,
W83-03042 5B

BRITISH COLUMBIA
Test of an Equation for Evaporation From Bare Soil,
W83-02929 2G

BULK PRECIPITATION
Chemical Composition of Bulk Precipitation in the North-Central and Northeastern United States, December 1980 Through February 1981,
W83-02968 2K

BULKING SLUDGE
The Effect of Aeration Basin Configuration on Activated Sludge Bulking at Low Organic Loading,
W83-03120 5D

CADMIUM
Sorption and Sedimentation of Zn and Cd by Seston in Southern Lake Michigan,
W83-03083 5B

CALCITE
Calcium Carbonate in Postglacial Lake Erie Sediment,
W83-02809 2J

CALCIUM CARBONATE
Nitrification Process in a Packed Bed Reactor With a Chemically Active Bed,
W83-02947 5D

CALCIUM CHLORIDE
Hydrodynamic Dispersion During Unsteady, Unsaturated Water Flow in a Clay Soil,
W83-03001 2G

CALCULATION METHODS
An Experimental Investigation of Evapotranspiration Estimation Methods,
W83-03034 2D

CALIBRATIONS
Calibration and Field Testing of a Two-Probe Gamma Gauge,
W83-02964 7B

CALIFORNIA
Water Policy: A California Split,
W83-02838 3F

Statewide Evaluation of Trace Element Accumulation From Long Term Disposal of Waste Water,
W83-02892 3C

Instream Flow Requirements of Native California Stream Fishes,
W83-02906 6G

Combined Water-Fertilizer Management to Minimize Non-Point Water Pollution While Achieving High Crop Production,
W83-02907 2I

Salinity and Boron Control Under High-Frequency Low-Volume Irrigation,
W83-02908 5B

The Striped Bass Decline in the San Francisco Bay-Delta Estuary,
W83-02919 5C

On Lagrangian Residual Currents With Applications in South San Francisco Bay, California,
W83-02928 2L

Effects of Aggradation and Degradation on Riffle-Pool Morphology in Natural Gravel Channels, Northwestern California,
W83-02936 2J

Spatial Variability of Surface Temperature Along Two Transects of a Bare Soil,
W83-02940 2G

Metabolism of California Stream Fishes,
W83-02944 5C

Delineation and Hydrologic Effects of a Gasoline Leak at Stovepipe Wells Hotel, Death Valley National Monument, California,
W83-02982 5B

Evapotranspiration of Applied Water, Central Valley, California, 1957-78,
W83-02984 2D

The Effect of Aeration Basin Configuration on Activated Sludge Bulking at Low Organic Loading,
W83-03120 5D

Water Conservation Kits: A Time Series Analysis of a Conservation Policy,
W83-03136 3D

CAMERA INTERFACING
Computer-Linked CCD Camera for Sediment Shape Analysis,
W83-03111 7B

CANADA
Behavior of Fishes in the Desaulniers River Basin After Filling of the Desaulniers Reservoir (Comportement Des Poissons Du Bassin De La Riviere Desaulniers Apres Le Remplissage Du Reservoir Desaulniers),
W83-03050 6G

Economic and Environmental Issues of the Proposed Extension of the Winter Navigation Season and Improvements on the Great Lakes-St. Lawrence Seaway System,
W83-03072 6G

Changes in Marsh Area Along the Canadian Shore of Lake Ontario,
W83-03076 4C

CAPILLARY SUCTION TIME
Theoretical and Experimental Study of Factors Affecting Capillary Suction Time (CST),
W83-02955 5D

CARDIOVASCULAR DISEASE
The Relationship of Minerals Commonly Found in Drinking Water to Atherosclerosis and Hypertension in Pigeons,
W83-03081 5C

CARP
Reproductively Limited Grass Carp for Biological Control of Aquatic Weeds--Broodstock Production and Testing,
W83-02898 4A

CARRYOVER STORAGE
Storage Requirements to Sustain Gross Reservoir Outflow From Small Basins in Kansas,
W83-02992 2E

CATCHMENT AREA
Updip Delineation of the Tertiary Limestone Aquifer, South Carolina,
W83-02896 2F

CATFISH FARMING
The Influence of Water Exchange On Water Quality and Fish Production in Channel Catfish Ponds,
W83-02905 5G

CATFISH PONDS
Effects of Water Exchange on Water Quality in Channel Catfish Ponds,
W83-02897 5G

The Influence of Water Exchange On Water Quality and Fish Production in Channel Catfish Ponds,
W83-02905 5G

CHANNEL MORPHOLOGY
Channel Design to Minimize Lining Material Costs,
W83-02837 8G

Effects of Aggradation and Degradation on Riffle-Pool Morphology in Natural Gravel Channels, Northwestern California,
W83-02936 2J

Streamflow Characteristics Related to Channel Geometry of Streams in Western United States,
W83-02969 2E

CHELATING AGENTS
EDTA as a Kinetic Inhibitor of Copper(II) Sulfide Precipitation,
W83-02956 5B

CHELATION
The Measurement of Complexation Capacity and Conditional Stability Constants for Ligands in Natural Waters,
W83-02957 5A

Trace Metal Complexation by Fulvic Acid Extracted from Sewage Sludge: II. Development of Chemical Models,
W83-03030 5B

CHEMICAL ANALYSIS
The Measurement of Total Phosphorus in Waste Water (Le Dosage du Phosphore Total Dans Les Eaux Usees),
W83-02816 5A

Chemical Composition of Bulk Precipitation in the North-Central and Northeastern United States, December 1980 Through February 1981,
W83-02968 2K

CHEMICAL COAGULATION
Effect of Solution Chemistry on Coagulation with Hydrolyzed Al(III): Significance of Sulfate Ion and pH,
W83-02949 5F

CHEMICAL COMPOSITION
Chemistry of South Polar Snow,
W83-03119 2K

CHEMICAL OXYGEN DEMAND
Elimination of the Chloride Interference in the Determination of the COD (Beseitigung der Chlorid-Storung Bei Der Bestimmung Des CSB),
W83-02814 5A

CHEMICAL REACTIONS
Effect of Solution Chemistry on Coagulation with Hydrolyzed Al(III): Significance of Sulfate Ion and pH,
W83-02949 5F

Rate Constants of Reactions of Ozone with Organic and Inorganic Compounds in Water--I. Non-Dissociating Organic Compounds,
W83-02950 5F

Rate Constants of Reactions of Ozone With Organic and Inorganic Compounds in Water--II. Dissociating Organic Compounds,
W83-02951 5F

CHEMISTRY OF PRECIPITATION
EDTA as a Kinetic Inhibitor of Copper(II) Sulfide Precipitation,
W83-02956 5B

Chemical Composition of Bulk Precipitation in the North-Central and Northeastern United States, December 1980 Through February 1981,
W83-02968 2K

Nutrients and Acid in Rain and Dry Fallout at Fayetteville, Arkansas (1980-1982),
W83-03041 2K

CHLORIDES
Elimination of the Chloride Interference in the Determination of the COD (Beseitigung der Chlorid-Storung Bei Der Bestimmung Des CSB),
W83-02814 5A

CHLORINATED HYDROCARBONS
Volatilization of Organic Trace Contaminants by Air Stripping for Water Reclamation,
W83-02917 5D

A Saponification Procedure for the Determination of Some Chlorinated Hydrocarbons in Fish,
W83-03077 5A

Characterization and Treatability of the By-Products of Chlorination of Naturally Occurring Humic Substances,
W83-03106 5F

CHLORINATION
A Theoretical and Experimental Investigation of the Dynamics of Breakpoint Chlorination in Dispersed Flow Reactors,
W83-02926 5F

Artifacts and Losses in the Sampling of Chlorinated Waters by XAD Adsorption,
W83-03104 5A

Characterization and Treatability of the By-Products of Chlorination of Naturally Occurring Humic Substances,
W83-03106 5F

CHLORINE
Characterization and Treatability of the By-Products of Chlorination of Naturally Occurring Humic Substances,
W83-03106 5F

CHLOROCHOLINE CHLORIDE
Pollution of Ground Waters by Chlorocholine Chloride Used in Agriculture (Voprosy Zagryazneniya Gruntovykh Vod Pri Primenenii Khlorkholinkhlorida V Selyskom Khozyaistve),
W83-03011 5B

CHLOROPHYTA
Toxicity Assessment of Snowmelt Water Runoff in an Urban Area (Toxicite Des Eaux De Ruissellement De La Fonte De Neige En Milieu Urbain),
W83-02958 5C

CHOLINE CHLORIDE
Pollution of Ground Waters by Chlorocholine Chloride Used in Agriculture (Voprosy Zagryazneniya Gruntovykh Vod Pri Primenenii Khlorkholinkhlorida V Selyskom Khozyaistve),
W83-03011 5B

CISTERNS
Microbial Quality of Water in Old Wells and the Public Water Distribution System in the U. S. Virgin Islands,
W83-03098 5F

Microbial Analysis of Domestic Cistern Water in the U. S. Virgin Islands,
W83-03099 5F

CLARIFICATION
Mechanism of Clarification Failure,
W83-02807 5D

Flotation as the Final Clarification Step in Waste-Water Treatment and its Influence on the Oxygen Balance of Receiving Waters,
W83-02848 5D

CLARIFIERS
Suppression of Density Waves in Clarifiers,
W83-02880 8B

CLAY LOAM
Midseason Soil Water Recharge for Corn in the Northwestern Corn Belt,
W83-02890 2G

CLAYS
Water Adsorption and Swelling of Clay Minerals in Soil Systems,
W83-02996 2G

Hydrodynamic Dispersion During Unsteady, Unsaturated Water Flow in a Clay Soil,
W83-03001 2G

CLIMATIC INDEX
Variations in Groundwater Quality with Drought,
W83-03044 5B

CLOGGING
Wastewater Injection Well Problems, Processes and Standards,
W83-03102 5E

COAGULATION
Coagulation and Removal of Algal Suspensions From Wastewater Stabilization Ponds,
W83-02903 5D

Colour and Turbidity Removal With Reusable Magnetite Particles--IV. Alkali Activated Magnetite--A New Solid, Reusable Coagulant-Adsorbent,
W83-02948 5F

COAL MINES
Salt Generation in Pyritic Coal Spoils and its Effect on Saturated Hydraulic Conductivity,
W83-03024 5B

COAL MINING
Methodology for Hydrologic Evaluation of a Potential Surface Mine: Loblolly Branch Basin, Tuscaloosa County, Alabama,
W83-02976 6G

The Impact of Energy Development in the Tongue River Basin, Southeastern Montana,
W83-03139 4C

COASTAL STREAMS
Sources, Sinks, and Storage of River Sediment in the Atlantic Drainage of the United States,
W83-03117 2J

COASTAL WATERS
Sources of Petroleum Hydrocarbon Inputs to the Marine Environment,
W83-02863 5B

Stream Function Finite Elements for Nearshore Current,
W83-03064 2L

COLOR
Determination of the Colour of Water and Waste Water (Bestimmung der Farbigkeit Von Wassern),
W83-02819 5A

COLORADO
Salinity Investigations in West Salt Creek, Colorado,
W83-02925 5B

An in Situ Comparison of the Effectiveness of Four Algicides,
W83-03137 5D

COLORADO RIVER BASIN
Defining Cost-Effective Salinity Control Programs,
W83-02829 5G

COMMERICAL FISH
Reproductively Limited Grass Carp for Biological Control of Aquatic Weeds--Broodstock Production and Testing,
W83-02898 4A

COMPACTION
Water Adsorption and Swelling of Clay Minerals in Soil Systems,
W83-02996 2G

COMPUTER FOURIER ANALYSIS
Computer-Linked CCD Camera for Sediment Shape Analysis,
W83-03111 7B

COMPUTER MODELS
Flow Model of the Hudson River Estuary From Albany to New Hamburg, New York,
W83-02986 2L

Preliminary Projections of the Effects of Chloride-Control Structures on the Quaternary Aquifer at Great Salt Plains, Oklahoma,
W83-02988 5G

Modeling Direct Recharge of Surficial Aquifers,
W83-03101 2F

COMPUTERS
Telecontrol and the Computer in Water Supply (Telesurveillance Et Ordinateur Au Service Des Eaux),
W83-02846 5F

Computer Control in a Biological Sewage Plant, Methods and Experience,
W83-02851 5D

Utilization of Computerized Water Monitoring and Information System,
W83-02883 7A

Modern Information Systems for Water Supply Companies-Requirements and Functions (Moderne Informationssysteme Fur Wasserwarten - Anforderungen Und Funktionen),
W83-03058 7A

CONFINED AQUIFER
Updip Delineation of the Tertiary Limestone Aquifer, South Carolina,
W83-02896 2F

CONFINING BEDS
Updip Delineation of the Tertiary Limestone Aquifer, South Carolina,
W83-02896 2F

CONNECTICUT
Radium, Thorium and Radioactive Lead Isotopes in Groundwaters: Application to the in Situ Determination of Adsorption-Desorption Rate Constants and Retardation Factors,
W83-02937 2K

CONSTRUCTION MATERIALS
River and Watercourse Crossings and Lake Outlets With HDPE Pipes (Fluss- und Gewasserkreuzungen Sowie Seeauslaufleitungen Mit Rohren Aus HDPE),
W83-02803 8G

CONSUMPTIVE USE
Weather and Consumptive Use in the Bear River Basin, Idaho During 1982,
W83-02911 2D

Estimated Water Use in Florida, 1980,
W83-02990 6D

CONTACT STABILIZATION
Team Effort Solves Operational Problems,
W83-02805 5D

CONTROL SYSTEMS
Automation Study of Activated Sludge Processes,
W83-02909 5D

Laboratory Study of Dynamic-State Control of Activated Sludge Processes,
W83-02910 5D

CONVECTION
Toxic Substance Models for the Upper Mississippi and Missouri Rivers,
W83-03114 5B

COOLING WATER
Physical and Chemical Properties of Pond Waters Receiving Warm-Water Effluent from a Thermal Power Plant,
W83-02954 5C

COPPER
Identification of Total and Biologically Sensitive Forms of Toxic Metal Inputs to an Urban Affected River,
W83-03105 5A

COPPER SPECIATION
Identification of Total and Biologically Sensitive Forms of Toxic Metal Inputs to an Urban Affected River,
W83-03105 5A

CORE DRILLING
Geologic and Well-Construction Data for the H-7 Borehole Complex Near the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-02977 4B

CORES
Geologic and Well-Construction Data for the H-7 Borehole Complex Near the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-02977 4B

CORN
A Water Use Comparison Between Corn and Sunflower,
W83-02828 2I

Midseason Soil Water Recharge for Corn in the Northwestern Corn Belt,
W83-02890 2G

CORROSION CONTROL
Corrosion Behavior of Passivatable Stainless Steel Under Reducing Conditions with Simultaneous Abrasive Stress (Das Korrosionsverhalten Passivierbarer Nichtrostender Stahle in Wassern Unter Reduzierenden Bedingungen Bei Gleichzeitiger Abrasiver Beanspruchung),
W83-03047 8G

COST ALLOCATION
The Legislative Reality of a National Water Policy,
W83-02923 6E

COST ANALYSIS
Defining Cost-Effective Salinity Control Programs,
W83-02829 5G

Effectiveness of Treatment to Meet Phosphorus Objectives in the Great Lakes,
W83-02830 5G

Channel Design to Minimize Lining Material Costs,
W83-02837 8G

A Model of Costs for Treating Drinking Water,
W83-03089 5F

Aerobic Thermophilic Stabilization of Sludge Versus Anaerobic Digestion and Other Kinds of Sludge Treatment at Middle-Sized Plants with Respect to Power Conservation and Economy,
W83-03121 5D

COST-ENERGY RECOVERY
Energy Recovery From the Reject Brine of Reverse Osmosis Systems,
W83-03113 3A

COSTS
Costs for Supplying Alternative Community Water and Sanitation Systems in Brazil,
W83-03092 6C

CRAYFISH
An Ecological Study of Ozark Streams,
W83-02916 6G

CROP YIELD
Midseason Soil Water Recharge for Corn in the Northwestern Corn Belt,
W83-02890 2G

Water Management and Salinity Control in Irrigated Swelling and Shrinking Soils,
W83-03038 3F

CRYSTALLIZATION
Design and Evaluation of an AFVC Wash Column With Direct Melting on the Ice Plug,
W83-03040 3A

CULTURES
Research Into the Mass Culture of Algae in Closed Systems,
W83-02854 5D

DAM CONSTRUCTION
Precaution Measures Against Uplift and Seepage Effects on Gigerwald Arch-Dam (Mesures De Protection Contre Les Effects De La Sous-Pression et Des Infiltrations Au Barrage-Voute De Gigerwald),
W83-02960 8E

DATA ACQUISITION
Computer-Linked CCD Camera for Sediment Shape Analysis,
W83-03111 7B

DATA AQUISITION
Water-Data Program of the U.S. Geological Survey,
W83-02967 7A

DATA COLLECTIONS
Water Resources and Data-Network Assessment of the Manasota Basin, Manatee and Sarasota Counties, Florida,
W83-02973 7A

Techniques for Estimating Flood Discharges for Unregulated Streams in New Mexico,
W83-02981 2E

Data Filtering for Large Area Analysis-An Example From the Canadian Nearshore Zone of the Great Lakes,
W83-03085 7C

DATA STORAGE AND RETRIEVAL
Water-Data Program of the U.S. Geological Survey,
W83-02967 7A

DECISION MAKING
The Use of Water Quality Models in Management Decision Making,
W83-02847 5G

DECOMPOSING ORGANIC MATTER
Metal Ion Complexation by Aquatic Humus. III. Model Development and Relation to Surface Water. (Komplexierung Von Metallionen Durch Gewasserhuminstoffe. III. Modellentwicklung und Gewasserbezug),
W83-02818 5B

DEGRADATION
The Influence of Adsorption on Glass, pH and Temperature on the Disappearance of Permethrin in Aqueous Systems,
W83-03057 5B

DENITRIFICATION
Kinetics of Dissimilatory Nitrate and Nitrite Reduction in Suspended Growth Culture,
W83-02806 5D

DENSITY WAVES
Suppression of Density Waves in Clarifiers,
W83-02880 8B

DEOXYGENATION
Behavior of Fishes in the Desaulniers River Basin After Filling of the Desaulniers Reservoir (Comportement Des Poissons Du Bassin De La Riviere Desaulniers Apres Le Remplissage Du Reservoir Desaulniers),
W83-03050 6G

DEPOSITION
Chemical Composition of Bulk Precipitation in the North-Central and Northeastern United States, December 1980 Through February 1981,
W83-02968 2K

DESALINATION
Sanitary Microbiologic Assessment of Water Desalination by Distillation (Sanitarno-Mikrobiologicheskaya Otsenka Distillyatsionnogo Metoda Opresneniya Vody),
W83-03010 3A

Energy Recovery From the Reject Brine of Reverse Osmosis Systems,
W83-03113 3A

DESALINATION PLANTS
Design and Evaluation of an AFVC Wash Column With Direct Melting on the Ice Plug,
W83-03040 3A

DESIGN CRITERIA
Use of EPA's CAPDET Program for Evaluation of Wastewater Treatment Alternatives,
W83-02804 5D

Scale-Up Problems,
W83-02861 5D

Small Hydro Needs Its Own Experts.
W83-03013 8A

Evaluation of Rapid Reservoir Storage-Yield Procedures,
W83-03061 4A

Safety Factors for Probabilistic Slope Design,
W83-03090 8D

DETENTION RESERVOIRS
Effects of a Floodwater-Retarding Structure on the Hydrology and Ecology of Trout Creek in Southwestern Wisconsin.
W83-02985 6G

A Modeling Approach for Storm Water Quantity and Quality Control Via Detention Basins,
W83-03147 5G

DETRITUS
Microbial Degradation of Natural and Pollutionally-Derived Lignocellulosic Detritus in Wetland Ecosystems,
W83-02913 5B

DEVELOPING COUNTRIES
Low-Cost Technology for Water Pollution Control in Developing Countries,
W83-02858 5D

Theme 5: Water Pollution Control in Developing Countries: Report of the Session Convenor,
W83-02873 6F

Legal and Administrative Aspects,
W83-02874 5G

Water Pollution Control in Developing Areas - Training and Education,
W83-02875 5G

Water Pollution Control in Developing Areas: Problems and Needs,
W83-02876 5G

Energy for Rural Development,
W83-03008 8C

Costs for Supplying Alternative Community Water and Sanitation Systems in Brazil,
W83-03092 6C

DIFFUSION
Toxic Substance Models for the Upper Mississippi and Missouri Rivers,
W83-03114 5B

DIGESTED DAIRY MANURE
Prediction of the Response of Pond Biota to Animal Waste Fertilization,
W83-03103 5C

DIRECT MELT WASH COLUMN
Design and Evaluation of an AFVC Wash Column With Direct Melting on the Ice Plug,
W83-03040 3A

DISINFECTION
Toxicological Problems Associated with Alternative Methods of Disinfection,
W83-03087 5C

DISPERSION
Hydrodynamic Dispersion During Unsteady, Unsaturated Water Flow in a Clay Soil,
W83-03001 2G

DISSOLVED HYDROCARBONS
Hydrocarbon Spills, Their Retention in the Subsurface and Propagation into Shallow Aquifers,
W83-02895 5B

DISSOLVED OXYGEN
Reaeration Rate Estimation Using the Lag in Dissolved Oxygen Concentration,
W83-02914 5A

DISSOLVED SALTS
Salinity Investigations in West Salt Creek, Colorado,
W83-02925 5B

DISSOLVED SOLIDS
Metal Ion Complexation by Aquatic Humus. III. Model Development and Relation to Surface Water. (Komplexierung Von Metallionen Durch Gewasserhuminstoffe. III. Modellentwicklung und Gewasserbezug),
W83-02818 5B

Salt Generation in Pyritic Coal Spoils and its Effect on Saturated Hydraulic Conductivity,
W83-03024 5B

DISTILLATION
Sanitary Microbiologic Assessment of Water Desalination by Distillation (Sanitarno-Mikrobiologicheskaya Otsenka Distillyatsionnogo Metoda Opresneniya Vody),
W83-03010 3A

Design and Evaluation of an AFVC Wash Column With Direct Melting on the Ice Plug,
W83-03040 3A

DISTRIBUTION
Vertical Distribution of Profundal Benthos in Lake Superior Sediments,
W83-02822 2H

DRINKING WATER
Drinking Water and Legionnaires' Disease,
W83-03067 5F

Comparative Inactivation of Six Enteroviruses by Ozone,
W83-03068 5F

Recent Developments in Water Treatment in France,
W83-03069 5F

Toxicological Problems Associated with Alternative Methods of Disinfection,
W83-03087 5C

The Role of Filtration in Preventing Waterborne Disease,
W83-03088 5F

A Model of Costs for Treating Drinking Water,
W83-03089 5F

DROUGHT
Variations in Groundwater Quality with Drought,
W83-03044 5B

DROUGHT RESISTANCE
A Water Use Comparison Between Corn and Sunflower,
W83-02828 2I

DRUM
Food of Freshwater Drum in Western Lake Erie,
W83-02810 2H

DRYLAND
Weather and Consumptive Use in the Bear River Basin, Idaho During 1982,
W83-02911 2D

DYNAMIC PROGRAMMING
Incremental Dynamic Programming May Yield Nonoptimal Solutions,
W83-02941 4A

ECOLOGY
Effects of a Floodwater-Retarding Structure on the Hydrology and Ecology of Trout Creek in Southwestern Wisconsin.
W83-02985 6G

ECONOMIC ASPECTS
Balancing Benefits and Expenditure in Water Pollution Control,
W83-02862 6B

Funding Water Pollution Control in South Africa,
W83-02870 6F

Funding Water Pollution Research,
W83-02871 9C

Costs for Supplying Alternative Community Water and Sanitation Systems in Brazil,
W83-03092 6C

An Assessment of the Economic Magnitude of Environmental Damage From Acid Precipitation in the Adirondacks,
W83-03095 6B

ECONOMIC EFFECTS
The Potential Impact of Water Reallocations on Agriculture in Idaho,
W83-03143 6B

ECONOMIC EVALUATION
Use of EPA's CAPDET Program for Evaluation of Wastewater Treatment Alternatives,
W83-02804 5D

An Economic Analysis of Integrated Fisheries Management: The Case of the Lake Michigan Alewife and Salmonid Fisheries,
W83-02811 6B

Theme 3: The Economics of Water Pollution Control and Research: Introduction by the Session Convenor,
W83-02869 6B

ECONOMIC PREDICTION
Assessment of Economic, Social, and Institutional Impacts of Ground-Water Regulation of the Tillman Terrace Aquifer in Southwestern Oklahoma,
W83-03033 4B

ECOSYSTEMS
Ten Ecosystem Approaches to the Planning and Management of the Great Lakes,
W83-03082 6A

ECOSYTEMS
Aquatic Biology in Nederlo Creek, Southwestern Wisconsin,
W83-02978 6G

EDTA
EDTA as a Kinetic Inhibitor of Copper(II) Sulfide Precipitation,
W83-02956 5B

EDUCATION
Low-Cost Technology for Water Pollution Control in Developing Countries,
W83-02858 5D

EFFLUENTS
Guidelines for the Reduction of Wastewater Tax (Hinweise zur Reduzierung Der Abwasserabgabe),
W83-02801 6F

EGYPT
Agricultural Vs. Hydropower Tradeoffs in the Operation of the High Aswan Dam,
W83-02934 6B

ELASTICITY OF DEMAND
Price, Socioeconomic, and Climatic Influences on Residential Water Use in Southern Arizona,
W83-02894 6D

ELECTRIC POWER PRODUCTION
Geothermal Resources in the Northwestern Border (Recursos Geothermicos en la Frontera Noroccidental),
W83-03021 2F

ELECTRICAL EQUIPMENT
Development Potential for Low-Head Hydro,
W83-03005 8C

Small Pump-Turbines to Supplement Grid Capacity,
W83-03006 8C

ENERGY RECOVERY
Energy Recovery From the Reject Brine of Reverse Osmosis Systems,
W83-03113 3A

ENTRAINMENT
Impact of Power Plant Entrainment of Ichthyoplankton on Juvenile Recruitment of Four Fishes in Western Lake Erie in 1975-77,
W83-03075 5C

ENVIRONMENTAL EFFECTS
Changes in Abundance and Growth Characteristics of White Perch From the Mouth of the Bay of Quinte,
W83-02808 6G

Economic and Environmental Issues of the Proposed Extension of the Winter Navigation Season and Improvements on the Great Lakes-St. Lawrence Seaway System,
W83-03072 6G

ENVIRONMENTAL QUALITY
An Environmental Quality Index for the Great Lakes,
W83-03148 7C

EQUALIZING BASINS
An in Situ Comparison of the Effectiveness of Four Algicides,
W83-03137 5D

EROSION
Salinity Investigations in West Salt Creek, Colorado,
W83-02925 5B

Erosion of Banks Along Piedmont Urban Streams,
W83-02945 2J

A Numerical Study of Raindrop Impact Phenomena: The Rigid Case,
W83-03029 2J

Uruguay's Save Our Soils Campaign.
W83-03134 4D

Runoff and Water Quality From Three Soil Landform Units on Mancos Shale,
W83-03150 2J

EROSION CONTROL
Soil Conservation in the Coon Creek Basin, Wisconsin,
W83-02827 4D

Shore Protection in the Town of Stoney Creek, Southwest Lake Ontario, 1934-1979: Historical Changes and Durability of Structures,
W83-02842 4D

EROSION RATES
Sediment Transport in Alluvial Channels: Rates for Erosion and Deposition of Cohesive Sediments Literature Review and Experimental Design,
W83-03032 2J

Sources, Sinks, and Storage of River Sediment in the Atlantic Drainage of the United States,
W83-03117 2J

ERROR ANALYSIS
Turbulent Vertical Momentum Transfer in Stratified Environments,
W83-02901 2E

Soil Hydraulic Properties as Stochastic Processes: II. Errors of Estimates in a Heterogeneous Field,
W83-02999 2G

ESTIMATING EQUATIONS
Methodology for Hydrologic Evaluation of a Potential Surface Mine: Loblolly Branch Basin, Tuscaloosa County, Alabama,
W83-02976 6G

ESTUARIES
Mathematical Modelling of Estuaries and Coastal Waters,
W83-02867 2L

Flow Model of the Hudson River Estuary From Albany to New Hamburg, New York,
W83-02986 2L

Coupling of One- and Two-Dimensional Finite Elements for the Computation of Tidal Flow in Estuaries,
W83-03051 2L

Collocation Formulations for the Finite Element Analysis of Tidal and Transport Processes in Estuaries,
W83-03055 2L

ESTUARINE ENVIRONMENTS
Nutrient-Salinity Relationships in Four Estuaries of the Cape Province, South Africa,
W83-02889 5B

EVALUATION
Balancing Benefits and Expenditure in Water Pollution Control,
W83-02862 6B

Methodology for Hydrologic Evaluation of a Potential Surface Mine: Loblolly Branch Basin, Tuscaloosa County, Alabama,
W83-02976 6G

Evaluation of Rapid Reservoir Storage-Yield Procedures,
W83-03061 4A

EVAPORATION
Test of an Equation for Evaporation From Bare Soil,
W83-02929 2G

Time-Dependent, Linearized Two-Dimensional Infiltration and Evaporation from Nonuniform and Nonperiodic Strip Sources,
W83-02938 2G

EVAPORATORS
Sanitary Microbiologic Assessment of Water Desalination by Distillation (Sanitarno-Mikrobiologicheskaya Otsenka Distillyatsionnogo Metoda Opresneniya Vody),
W83-03010 3A

EVAPOTRANSPIRATION
Salinity and Boron Control Under High-Frequency Low-Volume Irrigation,
W83-02908 5B

Evaporative Flux From Wheat and Fallow in a Semiarid Climate,
W83-02965 2D

Evapotranspiration Before and After Clearing Phreatophytes, Gila River Flood Plain, Graham County, Arizona,
W83-02966 2D

Evapotranspiration of Applied Water, Central Valley, California, 1957-78,
W83-02984 2D

An Experimental Investigation of Evapotranspiration Estimation Methods,
W83-03034 2D

EXCESS RAINFALL
Floods in Maine, April-May 1979,
W83-02983 2E

EXPANSIVE SOILS
Water Management and Salinity Control in Irrigated Swelling and Shrinking Soils,
W83-03038 3F

EXPERIMENTAL DESIGN
Sediment Transport in Alluvial Channels: Rates for Erosion and Deposition of Cohesive Sedi-

ments Literature Review and Experimental Design,
W83-03032 2J

FACTOR ANALYSIS
Factors Controlling Blue-Green Algae Dominance in a Southwestern Reservoir,
W83-03109 5C

FARMS
The Potential Impact of Water Reallocations on Agriculture in Idaho,
W83-03143 6B

FATE OF POLLUTANTS
Mass Balance Modeling of Heavy Metals in Saginaw Bay, Lake Huron,
W83-02820 5B

The Survival of Bacterial Indicators in Lysimeters and Landfills,
W83-02886 5E

FEDERAL JURISDICTION
Federal Water Policy and New Mexico Water,
W83-02922 6E

The Legislative Reality of a National Water Policy,
W83-02923 6E

FEDERAL REPUBLIC OF GERMANY
The Successes of Increased Wastewater Treatment Plant Construction on the Rhine (Erfolge Verstarkten Klaranlagenbaus Am Rhein),
W83-02802 5G

Contents of Metals and Suspended Solids in the Rhine (Metallgehalt und Schwebstoffgehalt im Rhein),
W83-02813 5B

Computer Control in a Biological Sewage Plant, Methods and Experience,
W83-02851 5D

Utilization of Computerized Water Monitoring and Information System,
W83-02883 7A

Significance on the New Large Water Reservoir Schonbuhl and Its Consequences on the Landeswasserversorgung Stuttgart (Die Bedeutung Des Neuen Grossbehalters Schonbuhl Fur Die Landeswasserversorgung Stuttgart),
W83-02963 8A

Coupling of One- and Two-Dimensional Finite Elements for the Computation of Tidal Flow in Estuaries,
W83-03051 2L

Aerobic Thermophilic Stabilization of Sludge Versus Anaerobic Digestion and Other Kinds of Sludge Treatment at Middle-Sized Plants with Respect to Power Conservation and Economy,
W83-03121 5D

FERMENTATION
An Integrated Low Cost System for Treatment of Potato Processing Wasterwater Incorporating Anaerobic Fermentation and Phosphorus Removal,
W83-03[illegible]4 5D

FERTILIZERS
Combined Water-Fertilizer Management to Minimize Non-Point Water Pollution While Achieving High Crop Production,
W83-02907 2I

FILTER RATE
Theoretical and Experimental Study of Factors Affecting Capillary Suction Time (CST),
W83-02955 5D

FILTERS (INTERMITTENT SAND)
Wastewater Stabilization Lagoon Effluent Upgrading With Modified Intermittent Sand Filters,
W83-02902 5D

FILTRATION
Water and Air Renewal in Reservoirs (Les Reservoirs D'eau Potable. 1-Le Renouvellement Methodique de L'eau et de L'air Dans les Reservoirs),
W83-02815 5G

Soluble Reactive Phosphorus Measurements in Lake Michigan: Filtration Artifacts,
W83-03084 5A

The Role of Filtration in Preventing Waterborne Disease,
W83-03088 5F

FINANCING
Clean Water Act - The View From Here,
W83-02832 6E

Funding Water Pollution Research,
W83-02871 9C

FINITE DIFFERENCE METHODS
A Theoretical and Experimental Investigation of the Dynamics of Breakpoint Chlorination in Dispersed Flow Reactors,
W83-02926 5F

Toxic Substance Models for the Upper Mississippi and Missouri Rivers,
W83-03114 5B

FINITE ELEMENT ANALYSIS
Water Quality Modeling of the Equus beds Aquifer in South Central Kansas,
W83-03042 5B

Collocation Formulations for the Finite Element Analysis of Tidal and Transport Processes in Estuaries,
W83-03055 2L

Stream Function Finite Elements for Nearshore Current,
W83-03064 2L

FINITE ELEMENT METHOD
Aquifer Parameter Prediction by Numerical Modeling,
W83-02912 2F

Coupling of One- and Two-Dimensional Finite Elements for the Computation of Tidal Flow in Estuaries,
W83-03051 2L

FINLAND
Physical and Chemical Properties of Pond Waters Receiving Warm-Water Effluent from a Thermal Power Plant,
W83-02954 5C

FISH
The Influence of Sex, Size, and Season on Mirex Levels Within Selected Tissues of Lake Ontario Salmon,
W83-02841 5C

Instream Flow Requirements of Native California Stream Fishes,
W83-02906 6G

Metabolism of California Stream Fishes,
W83-02944 5C

Behavior of Fishes in the Desaulniers River Basin After Filling of the Desaulniers Reservoir (Comportement Des Poissons Du Bassin De La Riviere Desaulniers Apres Le Remplissage Du Reservoir Desaulniers),
W83-03050 6G

Ultrasonic Telemetry Studies of Fish Activity Near the Nanticoke Thermal Generating Station,
W83-03074 5C

Impact of Power Plant Entrainment of Ichthyoplankton on Juvenile Recruitment of Four Fishes in Western Lake Erie in 1975-77,
W83-03075 5C

A Saponification Procedure for the Determination of Some Chlorinated Hydrocarbons in Fish,
W83-03077 5A

Evaluation of EPA Un-Ionized Ammonia Toxicity Criteria,
W83-03091 5G

FISH DIETS
The Striped Bass Decline in the San Francisco Bay-Delta Estuary,
W83-02919 5C

FISH EGGS
The Striped Bass Decline in the San Francisco Bay-Delta Estuary,
W83-02919 5C

FISH FOOD ORGANISMS
Food of Freshwater Drum in Western Lake Erie,
W83-02810 2H

FISH HABITATS
Instream Flow Requirements of Native California Stream Fishes,
W83-02906 6G

FISH HARVEST
Changes in Abundance and Growth Characteristics of White Perch From the Mouth of the Bay of Quinte,
W83-02808 6G

FISH MANAGEMENT
An Economic Analysis of Integrated Fisheries Management: The Case of the Lake Michigan Alewife and Salmonid Fisheries,
W83-02811 6B

FISH REPODUCTION
Reproductively Limited Grass Carp for Biological Control of Aquatic Weeds--Broodstock Production and Testing,
W83-02898 4A

FISH TOXINS
The Striped Bass Decline in the San Francisco Bay-Delta Estuary,
W83-02919 5C

FISHERIES
Hydrologic and Water Quality Modeling for Instream Flow Strategies,
W83-02927 6C

FISHERY DAMAGES
An Assessment of the Economic Magnitude of Environmental Damage From Acid Precipitation in the Adirondacks,
W83-03095 6B

FISHING
The National Recreational Fishing Benefits of Water Pollution Control,
W83-03130 6B

FLOCCULATION
Investigations on the Elimination Efficiency of Metal Hydroxide Flocs Which are Made Hydrophobic by Precipitation in the Presence of Sodium Stearate (Untersuchungen Uber Die Eliminationswirkung Hydrophobierter Metalloxidhydrat-Flocken),
W83-02812 5D

FLOOD DATA
Techniques for Estimating Magnitude and Frequency of Floods in South Carolina,
W83-02979 2E

FLOOD PEAK
Techniques for Estimating Flood Discharges for Unregulated Streams in New Mexico,
W83-02981 2E

FLOOD ROUTING
Application of Numerical Simulation Techniques to Floodplain Management,
W83-02893 2E

FLOODPLAIN MANAGEMENT
Application of Numerical Simulation Techniques to Floodplain Management,
W83-02893 2E

FLOODPLAINS
Application of Numerical Simulation Techniques to Floodplain Management,
W83-02893 2E

FLOODS
Techniques for Estimating Magnitude and Frequency of Floods in South Carolina,
W83-02979 2E

Techniques for Estimating Flood Discharges for Unregulated Streams in New Mexico,
W83-02981 2E

Floods in Maine, April-May 1979,
W83-02983 2E

Transport of Heavy Metals on Suspended Sediments Under High Flow Conditions in a Mineralized Region of Wales,
W83-03048 5B

FLOODWATER
Effects of a Floodwater-Retarding Structure on the Hydrology and Ecology of Trout Creek in Southwestern Wisconsin.
W83-02985 6G

FLORIDA
Water Resources and Data-Network Assessment of the Manasota Basin, Manatee and Sarasota Counties, Florida,
W83-02973 7A

Aquifer Test Results, Green Swamp Area, Florida,
W83-02980 2F

Estimated Water Use in Florida, 1980,
W83-02990 6D

FLOTATION
Flotation as the Final Clarification Step in Waste-Water Treatment and its Influence on the Oxygen Balance of Receiving Waters,
W83-02848 5D

FLOW CHARACTERISTICS
Streamflow Characteristics Related to Channel Geometry of Streams in Western United States,
W83-02969 2E

FLOW DURATION
Flow Duration Curves in Tropical Equatorial Regions,
W83-03018 2E

FLOW MEASUREMENT
Streamflow Losses to Madison Group Rocks in the Little Belt and Big Snowy Mountains, Montana,
W83-02974 2E

FLOW RATES
Streamflow Losses to Madison Group Rocks in the Little Belt and Big Snowy Mountains, Montana,
W83-02974 2E

FLOW VELOCITY
Fast-Water Streams Deflected by Transverse Walls,
W83-03003 8B

FLUVIAL SEDIMENTS
Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Waters with the aid of Incubation Experiments. Part 2: Investigations on Nitrogen and Manganese Release (Bestimmung Von Nahrstoff- Und Metallfreisetzungsraten Aus Sedimenten Unweltbelasteter Fliessgewasserstau-Haltungen Mit Hilfe Von Inkubationsversuchen. Teil 2: Untersuchungen Zur Stickstoff-Und Manganfreisetzung),
W83-03052 5B

Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Water with the Aid of Incubation Experiments. Part 1: Determination of Rates of Phosphorus and Iron Release (Bestimmung von Nahrstoff- und Metall-Freisetzungsraten aus Sedimenten Umweltbelasteter Fliessgewasserstauhaltungen mit Hilfe von Inkubationsversuchen. Teil 1: Bestimmung von Phosphor- und Eisenfreisetzungsraten),
W83-03053 5B

FOOD HABITS
Food of Freshwater Drum in Western Lake Erie,
W83-02810 2H

FOOD PROCESSING
The Exhaustive Reuse of Water in Food Processing,
W83-02884 3E

FOOD-PROCESSING WASTES
An Integrated Low Cost System for Treatment of Potato Processing Wasterwater Incorporating Anaerobic Fermentation and Phosphorus Removal,
W83-03124 5D

FOREST WATERSHEDS
Organic Carbon and Oxygen Demand Relationships in Stormflow From Southern Pine Watersheds,
W83-03015 5B

Stream Temperature Under an Inadequate Buffer Strip in the Southeast Piedmont,
W83-03149 6G

FRACTURE PERMEABILITY
Contaminant Transport in Fractured Porous Media: Analytical Solutions for a System of Parallel Fractures,
W83-02933 5B

FRANCE
Sanitary Problems in Relationship With Tap Water Distributed in New or Recent Buildings of Paris (Problems Sanitaires Poses A Paris Par L'Eau Potable Dans Les Immeubles Neufs Ou Recents),
W83-02844 5F

Supply of a Rural Community in the Rhone Department by Means of Mid-Depth Drilling in the 'Molasse' of the Bas-Dauphine (Alimentation D'Une Commune Rurale Du Department Du Rhone Au Moyen D'Un Forage De Profondeur Moyenne Dans La ('Molasse' Du Bas-Dauphine),
W83-02845 3B

Recent Developments in Water Treatment in France,
W83-03069 5F

FREE SURFACES
Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Waters with the aid of Incubation Experiments. Part 2: Investigations on Nitrogen and Manganese Release (Bestimmung Von Nahrstoff- Und Metallfreisetzungsraten Aus Sedimenten Unweltbelasteter Fliessgewasserstau-Haltungen Mit Hilfe Von Inkubationsversuchen. Teil 2: Untersuchungen Zur Stickstoff-Und Manganfreisetzung),
W83-03052 5B

FREQUENCY ANALYSIS
Hydrologic and Water Quality Modeling for Instream Flow Strategies,
W83-02927 6C

Techniques for Estimating Magnitude and Frequency of Floods in South Carolina,
W83-02979 2E

FROZEN GROUND
Runoff and Soil Erosion on Frozen Soils in Northeastern Oregon,
W83-02826 2J

Transport of Water in Frozen Soil: I. Experimental Determination of Soil-Water Diffusivity Under Isothermal Conditions,
W83-03054 2C

FULVIC ACIDS
Trace Metal Complexation by Fulvic Acid Extracted from Sewage Sludge: II. Development of Chemical Models,
W83-03030 5B

FURROW IRRIGATION
Irrigation Water Management for Wide-Spaced Furrow Irrigation,
W83-03037 3F

Water Management and Salinity Control in Irrigated Swelling and Shrinking Soils,
W83-03038 3F

GAMMA PROBE
Calibration and Field Testing of a Two-Probe Gamma Gauge,
W83-02964 7B

GENERATORS
Small Pump-Turbines to Supplement Grid Capacity,
W83-03006 8C

GEOCHEM
Trace Metal Complexation by Fulvic Acid Extracted from Sewage Sludge: II. Development of Chemical Models,
W83-03030 5B

GEOCHEMISTRY
Possible Influences Upon Lake Development in the East African Rift Valleys,
W83-03115 2H

GEOHYDROLOGY
Hydrology of the Surficial Aquifer in the Floyd River Basin, Iowa,
W83-02993 2F

Groundwater Resources in the Juarez-El Paso Region (De Aguas Subterraneas en la Region de Juarez-El Paso),
W83-03020 2F

Use of Geologic and Water Yield Data from Ground Water Based Community Water Systems as a Guide for Ground Water Planning and Management,
W83-03046 4B

GEOLOGIC MAPPING
Updip Delineation of the Tertiary Limestone Aquifer, South Carolina,
W83-02896 2F

GEOLOGY
Geology and Ground-Water Resources of Oswego County, New York,
W83-02987 2F

GEOMORPHOLOGY
Stratigraphy and Water Table Relationships of Upland Loess-Derived Soils in South-Central Iowa,
W83-02998 2G

GEORGIA
Stream Temperature Under an Inadequate Buffer Strip in the Southeast Piedmont,
W83-03149 6G

GEOTHERMAL POWER
Geothermal Resources in the Northwestern Border (Recursos Geothermicos en la Frontera Noroccidental),
W83-03021 2F

GEOTHERMAL RESOURCES
Preliminary Studies of the Reservoir Capacity and the Generating Potential of the Baca Geothermal Field, New Mexico,
W83-02935 2F

GEOTHERMAL STUDIES
Geothermal Resources in the Banbury Hot Springs Area, Twin Falls County, Idaho,
W83-02972 2F

Opening of a Fault and Resulting Slip Due to Injection of Fluid for the Extraction of Geothermal Heat,
W83-03132 4B

GERMAN DEMOCRATIC REPUBLIC
Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Waters with the aid of Incubation Experiments. Part 2: Investigations on Nitrogen and Manganese Release (Bestimmung Von Nahrstoff- Und Metallfreisetzungsraten Aus Sedimenten Unweltbelasteter Fliessgewasserstau-Haltungen Mit Hilfe Von Inkubationsversuchen. Teil 2: Untersuchungen Zur Stickstoff-Und Manganfreisetzung),
W83-03052 5B

Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Water with the Aid of Incubation Experiments. Part 1: Determination of Rates of Phosphorus and Iron Release (Bestimmung von Nahrstoff- und Metall-Freisetzungsraten aus Sedimenten Umweltbelasteter Fliessgewasserstauhaltungen mit Hilfe von Inkubationsversuchen. Teil 1: Bestimmung von Phosphor- und Eisenfreisetzungsraten),
W83-03053 5B

GLACIAL AQUIFERS
Geology and Ground-Water Resources of Oswego County, New York,
W83-02987 2F

GLACIAL SEDIMENTS
Mobilization, Movement and Deposition of Active Subaerial Sediment Flows, Matanuska Glacier, Alaska,
W83-03116 2J

GRASSES
The Effect of Turfgrass Thatch on Water Infiltration Rates,
W83-03023 4A

GREAT LAKES
Effectiveness of Treatment to Meet Phosphorus Objectives in the Great Lakes,
W83-02830 5G

Economic and Environmental Issues of the Proposed Extension of the Winter Navigation Season and Improvements on the Great Lakes-St. Lawrence Seaway System,
W83-03072 6G

Ten Ecosystem Approaches to the Planning and Management of the Great Lakes,
W83-03082 6A

Data Filtering for Large Area Analysis-An Example From the Canadian Nearshore Zone of the Great Lakes,
W83-03085 7C

An Environmental Quality Index for the Great Lakes,
W83-03148 7C

GROUNDWATER
Geology and Ground-Water Resources of Oswego County, New York,
W83-02987 2F

Ground-Water Resources of the Arcadia-Minden Area, Louisiana,
W83-02991 2F

Hydrologic Data of the Lower Merrimack River Basin, Massachusetts, from Concord River, Lowell, to Plum Island, Newburyport,
W83-02994 7C

Modeling Direct Recharge of Surficial Aquifers,
W83-03101 2F

GROUNDWATER AVAILABILITY
Ground-Water Resources of the Arcadia-Minden Area, Louisiana,
W83-02991 2F

Use of Geologic and Water Yield Data from Ground Water Based Community Water Systems as a Guide for Ground Water Planning and Management,
W83-03046 4B

GROUNDWATER BASINS
Groundwater Resources in the Juarez-El Paso Region (De Aguas Subterraneas en la Region de Juarez-El Paso),
W83-03020 2F

GROUNDWATER CONTAMINATION
Removal of Pesticides and Herbicides by Means of Adsorption on Activated Carbon,
W83-02857 5G

Hydrocarbon Spills, Their Retention in the Subsurface and Propagation into Shallow Aquifers,
W83-02895 5B

GROUNDWATER DEPLETION
Is the Ogallala Going Dry.
W83-02839 3F

GROUNDWATER IRRIGATION
Assessment of Economic, Social, and Institutional Impacts of Ground-Water Regulation of the Tillman Terrace Aquifer in Southwestern Oklahoma,
W83-03033 4B

GROUNDWATER MANAGEMENT
Groundwater Resources in the Juarez-El Paso Region (De Aguas Subterraneas en la Region de Juarez-El Paso),
W83-03020 2F

Use of Geologic and Water Yield Data from Ground Water Based Community Water Systems as a Guide for Ground Water Planning and Management,
W83-03046 4B

Application of Linear Systems Theory and Linear Programming to Ground Water Management in Kansas,
W83-03142 4B

GROUNDWATER MINING
Supply of a Rural Community in the Rhone Department by Means of Mid-Depth Drilling in the 'Molasse' of the Bas-Dauphine (Alimentation D'Une Commune Rurale Du Department Du Rhone Au Moyen D'Un Forage De Profondeur Moyenne Dans La ('Molasse' Du Bas-Dauphine),
W83-02845 3B

GROUNDWATER MOVEMENT
Derivation of Vertically Averaged Equations Describing Multiphase Flow in Porous Media,
W83-02930 2F

GROUNDWATER POLLUTION
Delineation and Hydrologic Effects of a Gasoline Leak at Stovepipe Wells Hotel, Death Valley National Monument, California,
W83-02982 5B

Pollution of Ground Waters by Chlorocholine Chloride Used in Agriculture (Voprosy Zagryazneniya Gruntovykh Vod Pri Primenenii Khlorkholinkhlorida V Selyskom Khozyaistve),
W83-03011 5B

The Impact of Energy Development in the Tongue River Basin, Southeastern Montana,
W83-03139 4C

GROUNDWATER POTENTIAL
Supply of a Rural Community in the Rhone Department by Means of Mid-Depth Drilling in the 'Molasse' of the Bas-Dauphine (Alimentation D'Une Commune Rurale Du Department Du Rhone Au Moyen D'Un Forage De Profondeur Moyenne Dans La ('Molasse' Du Bas-Dauphine),
W83-02845 3B

GROUNDWATER QUALITY
Water Quality Modeling of the Equus beds Aquifer in South Central Kansas,
W83-03042 5B

Variations in Groundwater Quality with Drought,
W83-03044 5B

GROUNDWATER RECHARGE
Updip Delineation of the Tertiary Limestone Aquifer, South Carolina,
W83-02896 2F

Evapotranspiration of Applied Water, Central Valley, California, 1957-78,
W83-02984 2D

Modeling Direct Recharge of Surficial Aquifers,
W83-03101 2F

GROUNDWATER RESERVOIRS
Preliminary Studies of the Reservoir Capacity and the Generating Potential of the Baca Geothermal Field, New Mexico,
W83-02935 2F

GROUNDWATER SEEPAGE
Aquifer Parameter Prediction by Numerical Modeling,
W83-02912 2F

GUATEMALA
Building Water and Sanitation Projects in Rural Guatemala,
W83-03071 5F

HALOGENS
Characterization and Treatability of the By-Products of Chlorination of Naturally Occurring Humic Substances,
W83-03106 5F

HAWAII
Exposure to Microbial Aerosols From Activated Sludge Treatment,
W83-03097 5D

Wastewater Injection Well Problems, Processes and Standards,
W83-03102 5E

HAZARDOUS WASTES
A Simplified Scheme for the Analysis of Pollutants in Groundwater and Leachates Contaminated by Hazardous Chemicals,
W83-02904 5A

HEAT TREATMENT
Thermal Pretreatment of Sludges--A Field Demonstration,
W83-02831 5E

HEAVY METALS
Contents of Metals and Suspended Solids in the Rhine (Metallgehalt und Schwebstoffgehalt im Rhein),
W83-02813 5B

Metal Ion Complexation by Aquatic Humus. III. Model Development and Relation to Surface Water. (Komplexierung Von Metallionen Durch Gewasserhuminstoffe. III. Modellentwicklung und Gewasserbezug),
W83-02818 5B

Mass Balance Modeling of Heavy Metals in Saginaw Bay, Lake Huron,
W83-02820 5B

Organochlorine and Heavy Metal Residues in Standard Fillets of Coho and Chinook Salmon of the Great Lakes - 1980,
W83-02843 5C

Computation of the Index of Pollution Caused by Heavy Metals in River Sediment,
W83-03049 5B

Identification of Total and Biologically Sensitive Forms of Toxic Metal Inputs to an Urban Affected River,
W83-03105 5A

The Effects of pH and Redox Potential on the Release of Heavy Metals From Arkansas River Sediments,
W83-03112 5B

Leaching Characteristics of Industrial Metal Finishing Wastewater Treatment Plant Solids,
W83-03122 5E

HEAVYMETALS
Metal Input and Mobilization in Two Acid-Stressed Lake Watersheds in Maine,
W83-02891 5B

HISTORY
History of Accidental Pollutions Which Have Occurred in the World (Historique des Pollutions Accidentelles Survenues Dans Le Monde),
W83-02817 5B

HUMAN DISEASE
The Role of Filtration in Preventing Waterborne Disease,
W83-03088 5F

HUMIC ACIDS
Characterization and Treatability of the By-Products of Chlorination of Naturally Occurring Humic Substances,
W83-03106 5F

HYDRAULIC CONDUCTIVITY
Temperature Dependence of Unsaturated Hydraulic Conductivity of Two Soils,
W83-03000 2G

Bacterial Utilization of Simple Alcohols and Their Influence on Saturated Hydraulic Conductivity,
W83-03014 2G

Salt Generation in Pyritic Coal Spoils and its Effect on Saturated Hydraulic Conductivity,
W83-03024 5B

Overland Flow From Sloping Land: Effects of Perched Water Tables and Subsurface Drains,
W83-03028 4A

HYDRAULIC DIFFUSIVITY
Aquifer Test Results, Green Swamp Area, Florida,
W83-02980 2F

HYDRAULIC FRACTURING
Opening of a Fault and Resulting Slip Due to Injection of Fluid for the Extraction of Geothermal Heat,
W83-03132 4B

HYDRAULICS
Hydrology, Hydraulics, and Sediment Transport, Kankakee and Iroquois Rivers,
W83-02921 2J

HYDROELECTRIC PLANTS
Installed and Planned Mini Hydro,
W83-03007 8C

Energy for Rural Development,
W83-03008 8C

The Future of Underground Pumped Hydro.
W83-03012 8A

Small Hydro Needs Its Own Experts.
W83-03013 8A

HYDROELECTRIC POWER
Agricultural Vs. Hydropower Tradeoffs in the Operation of the High Aswan Dam,
W83-02934 6B

Development Potential for Low-Head Hydro,
W83-03005 8C

HYDROGEN ION CONCENTRATION
Nature and Extent of Acid Snowpacks in Pennsylvania,
W83-02943 2C

Nutrients and Acid in Rain and Dry Fallout at Fayetteville, Arkansas (1980-1982),
W83-03041 2K

The Effects of pH and Redox Potential on the Release of Heavy Metals From Arkansas River Sediments,
W83-03112 5B

HYDROGRAPHS
On Subsurface Stormflow: Predictions with Simple Kinematic Theory for Saturated and Unsaturated Flows,
W83-02931 2G

A Study of the Bed-Load Yield From a Watershed,
W83-03096 2J

HYDROLOGIC BUDGET
Evapotranspiration Before and After Clearing Phreatophytes, Gila River Flood Plain, Graham County, Arizona,
W83-02966 2D

HYDROLOGIC DATA
Water-Data Program of the U.S. Geological Survey,
W83-02967 7A

Design of Surface-Water Data Networks for Regional Information,
W83-02970 7A

Hydrologic Characteristics of Surface-Mined Land Reclaimed by Sludge Irrigation, Fulton County, Illinois,
W83-02975 5A

Floods in Maine, April-May 1979,
W83-02983 2E

Hydrologic Data of the Lake Cochituate Drainage Basin, Framingham-Natick, Massachusetts,
W83-02989 7C

Hydrologic Data of the Lower Merrimack River Basin, Massachusetts, from Concord River, Lowell, to Plum Island, Newburyport,
W83-02994 7C

HYDROLOGIC MODELS
Development of a Generalized Hydrologic Modelling System,
W83-02946 2E

HYDROLOGY
Hydrology, Hydraulics, and Sediment Transport, Kankakee and Iroquois Rivers,
W83-02921 2J

HYPERTENSION
The Relationship of Minerals Commonly Found in Drinking Water to Atherosclerosis and Hypertension in Pigeons,
W83-03081 5C

ICE
Economic and Environmental Issues of the Proposed Extension of the Winter Navigation Season and Improvements on the Great Lakes-St. Lawrence Seaway System,
W83-03072 6G

Mobilization, Movement and Deposition of Active Subaerial Sediment Flows, Matanuska Glacier, Alaska,
W83-03116 2J

IDAHO
Weather and Consumptive Use in the Bear River Basin, Idaho During 1982,
W83-02911 2D

Geothermal Resources in the Banbury Hot Springs Area, Twin Falls County, Idaho,
W83-02972 2F

The Potential Impact of Water Reallocations on Agriculture in Idaho,
W83-03143 6B

ILLINOIS
Waste From the Water Treatment Plant at Alton and Its Impact on the Mississippi River,
W83-02920 5E

Hydrology, Hydraulics, and Sediment Transport, Kankakee and Iroquois Rivers,
W83-02921 2J

Some Chemical Characteristics of Mine Drainage in Illinois,
W83-02971 5B

Hydrologic Characteristics of Surface-Mined Land Reclaimed by Sludge Irrigation, Fulton County, Illinois,
W83-02975 5A

IMAGE PROCESSING
Computer-Linked CCD Camera for Sediment Shape Analysis,
W83-03111 7B

IMPAIRED WATER QUALITY
Sanitary Problems in Relationship With Tap Water Distributed in New or Recent Buildings of Paris (Problems Sanitaires Poses A Paris Par L'Eau Potable Dans Les Immeubles Neufs Ou Recents),
W83-02844 5F

INCINERATION
Process Integration in Sludge Management,
W83-03135 5E

INDIA
Optimal Design of Small Reservoir Systems,
W83-02836 3B

Sedimentation and its Control in Nadis in the Indian Arid Zone - a Case Study,
W83-03133 2J

INDIANA
Management of Existing Reservoir Systems by Interactive Optimization,
W83-02924 6A

INDONESIA
Water Requirements for Flooded Rice Cultivation,
W83-03002 3F

INDUSTRIAL WATER
Water Recycling - Industrial Applications,
W83-02879 3E

INFILTRATION
Time-Dependent, Linearized Two-Dimensional Infiltration and Evaporation from Nonuniform and Nonperiodic Strip Sources,
W83-02938 2G

Water Diffusivity of a Field Soil,
W83-02995 2G

Absorption of Water by Soil: The Effect of a Surface Crust,
W83-02997 2G

INFILTRATION RATE
The Effect of Turfgrass Thatch on Water Infiltration Rates,
W83-03023 4A

INFILTRATION RATES
Infiltration as Affected by Long-Term Use of Sodic-Saline Water for Irrigation,
W83-03016 3C

INFLOW FORECASTING
Management of Existing Reservoir Systems by Interactive Optimization,
W83-02924 6A

INFORMATION EXCHANGE
Packaging of Information- Part and Parcel of Successful Technology Transfer,
W83-02859 7C

INHIBITION
Kinetics of Dissimilatory Nitrate and Nitrite Reduction in Suspended Growth Culture,
W83-02806 5D

Inhibition Modeling In Anaerobic Digestion,
W83-03126 5D

Elements of the Inhibition of Nitrifying Bacteria,
W83-03127 5D

INJECTION
Opening of a Fault and Resulting Slip Due to Injection of Fluid for the Extraction of Geothermal Heat,
W83-03132 4B

INJECTION WELL
Wastewater Injection Well Problems, Processes and Standards,
W83-03102 5E

INSECTICIDES
Lake Ontario Sediment-Mirex Relationships,
W83-02823 5B

The Influence of Adsorption on Glass, pH and Temperature on the Disappearance of Permethrin in Aqueous Systems,
W83-03057 5B

INSTITUTIONAL CONSTRAINTS
Problems, Issues, Constraints, and Barriers to Water Quality Planning and Management in Urban and Urbanizing Areas (SMSA's) in Tennessee,
W83-02899 6B

INSTREAM AERATION
Hydrologic and Water Quality Modeling for Instream Flow Strategies,
W83-02927 6C

INSTREAM FLOW
Instream Flow Requirements of Native California Stream Fishes,
W83-02906 6G

Hydrologic and Water Quality Modeling for Instream Flow Strategies,
W83-02927 6C

INTERNATIONAL AGREEMENTS
The Quality of Water of the Rio Bravo Basin (La Calidad De Las Aguas Del Bajo Rio Bravo),
W83-03019 6E

Surface Water Availability and Future Demand along the Border from Juarez to Matamoros (Disponibilidad de Aguas Superficiales Y su Demanda Futuro a lo Largo De la Franja Fronteriza Desde Ciudad Juarez, Chihuahua, Hasta Matamoros, Tamaulipas),
W83-03022 6E

INVERTEBRATES
Food of Freshwater Drum in Western Lake Erie,
W83-02810 2H

ION FLUX
Nutrients and Acid in Rain and Dry Fallout at Fayetteville, Arkansas (1980-1982),
W83-03041 2K

IOWA
Hydrology of the Surficial Aquifer in the Floyd River Basin, Iowa,
W83-02993 2F

Stratigraphy and Water Table Relationships of Upland Loess-Derived Soils in South-Central Iowa,
W83-02998 2G

Biological and Recreational Aspects of Water Level Management for Clear Lake, Iowa,
W83-03036 6G

IRON
Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Water with the Aid of Incubation Experiments. Part 1: Determination of Rates of Phosphorus and Iron Release (Bestimmung von Nahrstoff- und Metall-Freisetzungsraten aus Sedimenten Umweltbelasteter Fliessgewasserstauhaltungen mit Hilfe von Inkubationsversuchen. Teil 1: Bestimmung von Phosphor- und Eisenfreisetzungsraten),
W83-03053 5B

IRON COMPOUNDS
Colour and Turbidity Removal With Reusable Magnetite Particles--IV. Alkali Activated Magnetite--A New Solid, Reusable Coagulant-Adsorbent,
W83-02948 5F

IRRIGATION
Combined Water-Fertilizer Management to Minimize Non-Point Water Pollution While Achieving High Crop Production,
W83-02907 2I

Weather and Consumptive Use in the Bear River Basin, Idaho During 1982,
W83-02911 2D

Evapotranspiration of Applied Water, Central Valley, California, 1957-78,
W83-02984 2D

Field Tests Underwqy for Three New Agricultural Polymers.
W83-03129 3F

IRRIGATION DESIGN
Time-Dependent, Linearized Two-Dimensional Infiltration and Evaporation from Nonuniform and Nonperiodic Strip Sources,
W83-02938 2G

Irrigation Water Management for Wide-Spaced Furrow Irrigation,
W83-03037 3F

IRRIGATION EFFICIENCY
Water Policy: A California Split,
W83-02838 3F

Water Requirements for Flooded Rice Cultivation,
W83-03002 3F

IRRIGATION PRACTICES
Water Management and Salinity Control in Irrigated Swelling and Shrinking Soils,
W83-03038 3F

IRRIGATION RETURN FLOW
Effects of Farming Practices on Sediment in Irrigation Return Flow,
W83-03039 4D

IRRIGATION SCHEDULING
Irrigation Water Management for Wide-Spaced Furrow Irrigation,
W83-03037 3F

IRRIGATION WATER
Optimal Design of Small Reservoir Systems,
W83-02836 3B

Soil Pore Structural Stability and Irrigation Water Quality: III. Evaluation of Soil Stability and Crop Yield in Relation to Salinity and Sodicity,
W83-03025 2G

Soil Pore Structural Stability and Irrigation Water Quality: II. Sodium Stability Data,
W83-03026 2G

Soil Pore Structural Stability and Irrigation Water Quality: I. Empirical Sodium Stability Model,
W83-03027 2G

ISRAEL
Infiltration as Affected by Long-Term Use of Sodic-Saline Water for Irrigation,
W83-03016 3C

Optimal Annual Operation of a Water Supply and Distribution System,
W83-03062 6A

ITALY
Reservoir Capacity Conservation (Conservazione Della Capacita Utile Nei Laghi Artificiali),
W83-02953 8A

Atypical Mycobacteria Isolated at Catania (Microbatteri Atipici Isolati a Catania),
W83-03009 5A

JAPAN
Computation of the Index of Pollution Caused by Heavy Metals in River Sediment,
W83-03049 5B

Stream Function Finite Elements for Nearshore Current,
W83-03064 2L

JETS
Fast-Water Streams Deflected by Transverse Walls,
W83-03003 8B

KANSAS
Storage Requirements to Sustain Gross Reservoir Outflow From Small Basins in Kansas,
W83-02992 2E

Water Quality Modeling of the Equus beds Aquifer in South Central Kansas,
W83-03042 5B

Variations in Groundwater Quality with Drought,
W83-03044 5B

Application of Linear Systems Theory and Linear Programming to Ground Water Management in Kansas,
W83-03142 4B

KENTUCKY
Salt Generation in Pyritic Coal Spoils and its Effect on Saturated Hydraulic Conductivity,
W83-03024 5B

KINETICS
Kinetics of Dissimilatory Nitrate and Nitrite Reduction in Suspended Growth Culture,
W83-02806 5D

A Kinetic Model of Steady State Phosphorus Fixation in a Batch Reactor--IV,
W83-02952 5D

KRIGING TECHNIQUE
Soil Hydraulic Properties as Stochastic Processes: II. Errors of Estimates in a Heterogeneous Field,
W83-02999 2G

LAGRANGIAN CIRCULATION
On Lagrangian Residual Currents With Applications in South San Francisco Bay, California,
W83-02928 2L

LAKE
Biological and Recreational Aspects of Water Level Management for Clear Lake, Iowa,
W83-03036 6G

LAKE ERIE
Calcium Carbonate in Postglacial Lake Erie Sediment,
W83-02809 2J

Food of Freshwater Drum in Western Lake Erie,
W83-02810 2H

Lake Erie Oxygen Depletion Controversy,
W83-02824 5G

Wave Action and Bottom Shear Stresses in Lake Erie,
W83-03073 2H

Ultrasonic Telemetry Studies of Fish Activity Near the Nanticoke Thermal Generating Station,
W83-03074 5C

Impact of Power Plant Entrainment of Ichthyoplankton on Juvenile Recruitment of Four Fishes in Western Lake Erie in 1975-77,
W83-03075 5C

A Ten-year Study of Phytoplankton Biomass and Composition in the Nanticoke Region of Long Point Bay, Lake Erie,
W83-03080 2H

Turbidity in the Western Basin of Lake Erie,
W83-03118 2J

LAKE FISHERIES
Changes in Abundance and Growth Characteristics of White Perch From the Mouth of the Bay of Quinte,
W83-02808 6G

An Economic Analysis of Integrated Fisheries Management: The Case of the Lake Michigan Alewife and Salmonid Fisheries,
W83-02811 6B

LAKE HURON
Mass Balance Modeling of Heavy Metals in Saginaw Bay, Lake Huron,
W83-02820 5B

LAKE MICHIGAN
An Economic Analysis of Integrated Fisheries Management: The Case of the Lake Michigan Alewife and Salmonid Fisheries,
W83-02811 6B

Soluble Reactive Phosphorus Measurements in Lake Michigan: Causes of Method-Specific Differences,
W83-02821 5A

Lake-Wide Seasonal Changes in Limnological Conditions in Lake Michigan in 1976,
W83-03079 2H

Soluble Reactive Phosphorus Measurements in Lake Michigan: Filtration Artifacts,
W83-03084 5A

LAKE MORPHOLOGY
Possible Influences Upon Lake Development in the East African Rift Valleys,
W83-03115 2H

LAKE ONTARIO
Changes in Abundance and Growth Characteristics of White Perch From the Mouth of the Bay of Quinte,
W83-02808 6G

Lake Ontario Sediment-Mirex Relationships,
W83-02823 5B

Trends in Lake Ontario Surveillance Parameters, 1974-1980,
W83-02840 2H

The Influence of Sex, Size, and Season on Mirex Levels Within Selected Tissues of Lake Ontario Salmon,
W83-02841 5C

Shore Protection in the Town of Stoney Creek, Southwest Lake Ontario, 1934-1979: Historical Changes and Durability of Structures,
W83-02842 4D

Changes in Marsh Area Along the Canadian Shore of Lake Ontario,
W83-03076 4C

LAKE RESTORATION
Effectiveness of Treatment to Meet Phosphorus Objectives in the Great Lakes,
W83-02830 5G

Alum Control of Internal Phosphorus Loading in a Shallow Lake,
W83-03140 5G

LAKE SEDIMENTS
Calcium Carbonate in Postglacial Lake Erie Sediment,
W83-02809 2J

Mass Balance Modeling of Heavy Metals in Saginaw Bay, Lake Huron,
W83-02820 5B

Vertical Distribution of Profundal Benthos in Lake Superior Sediments,
W83-02822 2H

Retention of Benthic Invertebrates With Different Sieving Techniques,
W83-02825 2H

Turbidity in the Western Basin of Lake Erie,
W83-03118 2J

LAKE SHORES
Shore Protection in the Town of Stoney Creek, Southwest Lake Ontario, 1934-1979: Historical Changes and Durability of Structures,
W83-02842 4D

LAKE SUPERIOR
Vertical Distribution of Profundal Benthos in Lake Superior Sediments,
W83-02822 2H

LAKES
Lake Erie Oxygen Depletion Controversy,
W83-02824 5G

Wave Action and Bottom Shear Stresses in Lake Erie,
W83-03073 2H

Large Lakes of the World,
W83-03078 2H

Lake-Wide Seasonal Changes in Limnological Conditions in Lake Michigan in 1976,
W83-03079 2H

A Ten-year Study of Phytoplankton Biomass and Composition in the Nanticoke Region of Long Point Bay, Lake Erie,
W83-03080 2H

Ten Ecosystem Approaches to the Planning and Management of the Great Lakes,
W83-03082 6A

Sorption and Sedimentation of Zn and Cd by Seston in Southern Lake Michigan,
W83-03083 5B

Soluble Reactive Phosphorus Measurements in Lake Michigan: Filtration Artifacts,
W83-03084 5A

Data Filtering for Large Area Analysis-An Example From the Canadian Nearshore Zone of the Great Lakes,
W83-03085 7C

Effect of Atmospheric Sulfur Pollutants Derived from Acid Precipitation on the Benthic Dynamics of Lakes,
W83-03093 5C

LAND APPLICATION
New Method Simplifies Sludge Disposal.
W83-03070 5E

LAND DISPOSAL
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W83-02887 5B

Statewide Evaluation of Trace Element Accumulation From Long Term Disposal of Waste Water,
W83-02892 3C

LAND RECLAMATION
Hydrologic Characteristics of Surface-Mined Land Reclaimed by Sludge Irrigation, Fulton County, Illinois,
W83-02975 5A

Methodology for Hydrologic Evaluation of a Potential Surface Mine: Loblolly Branch Basin, Tuscaloosa County, Alabama,
W83-02976 6G

LAND USE
An Examination of Land Use - Nutrient Export Relationships,
W83-03144 5B

LANDFILLS
The Survival of Bacterial Indicators in Lysimeters and Landfills,
W83-02886 5E

Numerical Simulation of Flow and Contaminant Migration at an Extensively Monitored Landfill,
W83-02942 5B

Leaching Characteristics of Industrial Metal Finishing Wastewater Treatment Plant Solids,
W83-03122 5E

LEACHATE
The Enumeration of Streptococci and Mycobacteria Present in Landfill Leachate,
W83-02885 5B

LEACHATES
The Survival of Bacterial Indicators in Lysimeters and Landfills,
W83-02886 5E

LEACHING
Removal of Pesticides and Herbicides by Means of Adsorption on Activated Carbon,
W83-02857 5G

Leaching Characteristics of Industrial Metal Finishing Wastewater Treatment Plant Solids,
W83-03122 5E

LEAKAGE
Aquifer Test Results, Green Swamp Area, Florida,
W83-02980 2F

LEGAL ASPECTS
Legal and Administrative Control Aspects of Oil Pollution,
W83-02868 5G

Legal and Administrative Aspects,
W83-02874 5G

Changes Proposed for Water Management in the United Kingdom,
W83-03065 6E

LIGANDS
The Measurement of Complexation Capacity and Conditional Stability Constants for Ligands in Natural Waters,
W83-02957 5A

LIGNOCELLULOSE
Microbial Degradation of Natural and Pollutionally-Derived Lignocellulosic Detritus in Wetland Ecosystems,
W83-02913 5B

LIME DUST
Nature and Extent of Acid Snowpacks in Pennsylvania,
W83-02943 2C

LIMNOLOGY
Lake-Wide Seasonal Changes in Limnological Conditions in Lake Michigan in 1976,
W83-03079 2H

LINEAR PROGRAMMING
Assessment of Economic, Social, and Institutional Impacts of Ground-Water Regulation of the Tillman Terrace Aquifer in Southwestern Oklahoma,
W83-03033 4B

LININGS
Channel Design to Minimize Lining Material Costs,
W83-02837 8G

LOGGING
Stream Temperature Under an Inadequate Buffer Strip in the Southeast Piedmont,
W83-03149 6G

LOUISIANA
Use of EPA's CAPDET Program for Evaluation of Wastewater Treatment Alternatives,
W83-02804 5D

Ground-Water Resources of the Arcadia-Minden Area, Louisiana,
W83-02991 2F

LYSIMETER
An Experimental Investigation of Evapotranspiration Estimation Methods,
W83-03034 2D

MAGNETITE PROCESS
Water and Wastewater Treatment With Reusable Magnetite Particles,
W83-02852 5D

MAINE
Metal Input and Mobilization in Two Acid-Stressed Lake Watersheds in Maine,
W83-02891 5B

Floods in Maine, April-May 1979,
W83-02983 2E

Radon, Water, and Air Pollution: Risks and Control,
W83-03031 5C

MANAGEMENT
Ten Ecosystem Approaches to the Planning and Management of the Great Lakes,
W83-03082 6A

MANAGEMENT PLANNING
Changes Proposed for Water Management in the United Kingdom,
W83-03065 6E

MANCOS SHALE
Salinity Investigations in West Salt Creek, Colorado,
W83-02925 5B

MANGANESE
Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Waters with the aid of Incubation Experiments. Part 2: Investigations on Nitrogen and Manganese Release (Bestimmung Von Nahrstoff- Und Metallfreisetzungsraten Aus Sedimenten Unweltbelasteter Fliessgewasserstau-Haltungen Mit Hilfe Von Inkubationsversuchen. Teil 2: Untersuchungen Zur Stickstoff-Und Manganfreisetzung),
W83-03052 5B

MANURE
Pollution Potential Ranking of Barnyards for Priority Watershed Planning,
W83-02915 5G

MAPS
Changes in Marsh Area Along the Canadian Shore of Lake Ontario,
W83-03076 4C

MARGINAL COSTS
Price, Socioeconomic, and Climatic Influences on Residential Water Use in Southern Arizona,
W83-02894 6D

MARSHES
Changes in Marsh Area Along the Canadian Shore of Lake Ontario,
W83-03076 4C

MASS TRANSFER
Volatilization of Organic Trace Contaminants by Air Stripping for Water Reclamation,
W83-02917 5D

MASS-TRANSPORT MODELS
Water Quality Modeling of the Equus beds Aquifer in South Central Kansas,
W83-03042 5B

MASSACHUSETTS
Hydrologic Data of the Lake Cochituate Drainage Basin, Framingham-Natick, Massachusetts,
W83-02989 7C

Hydrologic Data of the Lower Merrimack River Basin, Massachusetts, from Concord River, Lowell, to Plum Island, Newburyport,
W83-02994 7C

Benefits of Pollution Control on Massachusetts' Housatonic River: A Hedonic Pricing Approach,
W83-03141 6B

MATHEMATICAL EQUATIONS
Transport of Water in Frozen Soil: I. Experimental Determination of Soil-Water Diffusivity Under Isothermal Conditions,
W83-03054 2C

Well Recharge in Idealized Rectangular Aquifers,
W83-03056 4B

Evaluation of Rapid Reservoir Storage-Yield Procedures,
W83-03061 4A

Proofs of the Volume Averaging Theorems for Multiphase Flow,
W83-03063 8B

Stream Function Finite Elements for Nearshore Current,
W83-03064 2L

MATHEMATICAL MODEL
Toxic Substance Models for the Upper Mississippi and Missouri Rivers,
W83-03114 5B

MATHEMATICAL MODELS
The Use of Mathematical Models in the Formulation of Pollution Control Policies - An Overview,
W83-02864 5

Pollution of Ground Waters by Chlorocholine Chloride Used in Agriculture (Voprosy Zagryazneniya Gruntovykh Vod Pri Primenenii Khlorkholinkhlorida V Selyskom Khozyaistve),
W83-03011 5B

MEASURING INSTRUMENTS
Calibration and Field Testing of a Two-Probe Gamma Gauge,
W83-02964 7B

MEMBRANE FOULING
The Application of Pretreatment Procedures to Limit Membrane Fouling in Reverse Osmosis Reclamation of Secondary Sewage Effluents,
W83-02849 5D

METABOLISM
Metabolism of California Stream Fishes,
W83-02944 5C

METALS
A Chemical Investigation of a Marine Sewage Outfall,
W83-02888 5B

The Measurement of Complexation Capacity and Conditional Stability Constants for Ligands in Natural Waters,
W83-02957 5A

Trace Metal Complexation by Fulvic Acid Extracted from Sewage Sludge: II. Development of Chemical Models,
W83-03030 5B

Transport of Heavy Metals on Suspended Sediments Under High Flow Conditions in a Mineralized Region of Wales,
W83-03048 5B

METEOROLOGICAL DATA
An Experimental Investigation of Evapotranspiration Estimation Methods,
W83-03034 2D

METHANE BACTERIA
Response of Methane Fermentation Systems to Industrial Toxicants,
W83-02833 5D

METHANOL
Bacterial Utilization of Simple Alcohols and Their Influence on Saturated Hydraulic Conductivity,
W83-03014 2G

MEXICO
Laws and Institutions That Regulate Surface Waters in Mexico (Commentarios a Las Leyes e Instituciones Que Reglamentan Las Aguas Superficiales de Mexico),
W83-03004 6E

The Quality of Water of the Rio Bravo Basin (La Calidad De Las Aguas Del Bajo Rio Bravo),
W83-03019 6E

Groundwater Resources in the Juarez-El Paso Region (De Aguas Subterraneas en la Region de Juarez-El Paso),
W83-03020 2F

Geothermal Resources in the Northwestern Border (Recursos Geothermicos en la Frontera Noroccidental),
W83-03021 2F

Surface Water Availability and Future Demand along the Border from Juarez to Matamoros (Disponibilidad de Aguas Superficiales Y su Demanda Futuro a lo Largo De la Franja Fronteriza Desde Ciudad Juarez, Chihuahua, Hasta Matamoros, Tamaulipas),
W83-03022 6E

MICROBIAL AEROSOLS
Exposure to Microbial Aerosols From Activated Sludge Treatment,
W83-03097 5D

MICROBIAL DEGRADATION
Microbial Degradation of Natural and Pollutionally-Derived Lignocellulosic Detritus in Wetland Ecosystems,
W83-02913 5B

MICROBIOLOGY
Sanitary Microbiologic Assessment of Water Desalination by Distillation (Sanitarno-Mikrobiologicheskaya Otsenka Distillyatsionnogo Metoda Opresneniya Vody),
W83-03010 3A

MICROORGANISMS
Microbiological Aerosols From a Field-Source Wastewater Irrigation System,
W83-02835 5B

Sanitary Microbiologic Assessment of Water Desalination by Distillation (Sanitarno-Mikrobiologicheskaya Otsenka Distillyatsionnogo Metoda Opresneniya Vody),
W83-03010 3A

MINE WASTES
Transport of Heavy Metals on Suspended Sediments Under High Flow Conditions in a Mineralized Region of Wales,
W83-03048 5B

MINERALS
Mineralization Problems in the PWV Complex - The Identification of Viable Solutions by Means of a Suite of Mathematical Models,
W83-02881 5G

The Relationship of Minerals Commonly Found in Drinking Water to Atherosclerosis and Hypertension in Pigeons,
W83-03081 5C

MINNESOTA
Midseason Soil Water Recharge for Corn in the Northwestern Corn Belt,
W83-02890 2G

MINNESOTA ANDOVER
Modeling Direct Recharge of Surficial Aquifers,
W83-03101 2F

MIREX
Lake Ontario Sediment-Mirex Relationships,
W83-02823 5B

The Influence of Sex, Size, and Season on Mirex Levels Within Selected Tissues of Lake Ontario Salmon,
W83-02841 5C

MISSISSIPPI
Organic Carbon and Oxygen Demand Relationships in Stormflow From Southern Pine Watersheds,
W83-03015 5B

MISSOURI RIVER
Toxic Substance Models for the Upper Mississippi and Missouri Rivers,
W83-03114 5B

MODEL STUDIES
Use of EPA's CAPDET Program for Evaluation of Wastewater Treatment Alternatives,
W83-02804 5D

The Use of Water Quality Models in Management Decision Making,
W83-02847 5G

Application to Estuarine and Coastal Waters,
W83-02865 5B

Application to Rivers and Underground Waters,
W83-02866 5G

Mathematical Modelling of Estuaries and Coastal Waters,
W83-02867 2L

Mineralization Problems in the PWV Complex - The Identification of Viable Solutions by Means of a Suite of Mathematical Models,
W83-02881 5G

Incremental Dynamic Programming May Yield Nonoptimal Solutions,
W83-02941 4A

Numerical Simulation of Flow and Contaminant Migration at an Extensively Monitored Landfill,
W83-02942 5B

Coupling of One- and Two-Dimensional Finite Elements for the Computation of Tidal Flow in Estuaries,
W83-03051 2L

Comparing Methods of Hydrologic Regionalization,
W83-03146 7C

MOMENTUM TRANSFER
Turbulent Vertical Momentum Transfer in Stratified Environments,
W83-02901 2E

MONITORING
Trends in Lake Ontario Surveillance Parameters, 1974-1980,
W83-02840 2H

Utilization of Computerized Water Monitoring and Information System,
W83-02883 7A

MONTANA
Evaporative Flux From Wheat and Fallow in a Semiarid Climate,
W83-02965 2D

Streamflow Losses to Madison Group Rocks in the Little Belt and Big Snowy Mountains, Montana,
W83-02974 2E

The Impact of Energy Development in the Tongue River Basin, Southeastern Montana,
W83-03139 4C

MORPHOLOGY
Possible Influences Upon Lake Development in the East African Rift Valleys,
W83-03115 2H

MORPHOMETRY
Large Lakes of the World,
W83-03078 2H

MULTIPHASE FLOW
Proofs of the Volume Averaging Theorems for Multiphase Flow,
W83-03063 8B

MULTIPLE REGRESSION DEMAND MODELS
Price, Socioeconomic, and Climatic Influences on Residential Water Use in Southern Arizona,
W83-02894 6D

MUNICIPAL WATER QUALITY
Variations in Groundwater Quality with Drought,
W83-03044 5B

MUTAGENS
Artifacts and Losses in the Sampling of Chlorinated Waters by XAD Adsorption,
W83-03104 5A

MYCOBACTERIA
The Enumeration of Streptococci and Mycobacteria Present in Landfill Leachate,
W83-02885 5B

Atypical Mycobacteria Isolated at Catania (Microbatteri Atipici Isolati a Catania),
W83-03009 5A

NEARSHORE PROCESSES
Stream Function Finite Elements for Nearshore Current,
W83-03064 2L

NETWORK DESIGN
Design of Surface-Water Data Networks for Regional Information,
W83-02970 7A

Water Resources and Data-Network Assessment of the Manasota Basin, Manatee and Sarasota Counties, Florida,
W83-02973 7A

NEUTRALIZATION
Nitrification Process in a Packed Bed Reactor With a Chemically Active Bed,
W83-02947 5D

NEVADA
Application of Numerical Simulation Techniques to Floodplain Management,
W83-02893 2E

NEW MEXICO
Federal Water Policy and New Mexico Water,
W83-02922 6E

Preliminary Studies of the Reservoir Capacity and the Generating Potential of the Baca Geothermal Field, New Mexico,
W83-02935 2F

Geologic and Well-Construction Data for the H-7 Borehole Complex Near the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-02977 4B

Techniques for Estimating Flood Discharges for Unregulated Streams in New Mexico,
W83-02981 2E

NEW YORK
Flow Model of the Hudson River Estuary From Albany to New Hamburg, New York,
W83-02986 2L

Geology and Ground-Water Resources of Oswego County, New York,
W83-02987 2F

Effect of Atmospheric Sulfur Pollutants Derived from Acid Precipitation on the Benthic Dynamics of Lakes,
W83-03093 5C

An Assessment of the Economic Magnitude of Environmental Damage From Acid Precipitation in the Adirondacks,
W83-03095 6B

NITRATE
Nature and Extent of Acid Snowpacks in Pennsylvania,
W83-02943 2C

NITRATES
Kinetics of Dissimilatory Nitrate and Nitrite Reduction in Suspended Growth Culture,
W83-02806 5D

NITRIFICATION
Nitrification Process in a Packed Bed Reactor With a Chemically Active Bed,
W83-02947 5D

Elements of the Inhibition of Nitrifying Bacteria,
W83-03127 5D

NITRITES
Kinetics of Dissimilatory Nitrate and Nitrite Reduction in Suspended Growth Culture,
W83-02806 5D

NITROGEN
Combined Water-Fertilizer Management to Minimize Non-Point Water Pollution While Achieving High Crop Production,
W83-02907 2I

Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Waters with the aid of Incubation Experiments. Part 2: Investigations on Nitrogen and Manganese Release (Bestimmung Von Nahrstoff- Und Metallfreisetzungsraten Aus Sedimenten Unweltbelasteter Fliessgewasserstau-Haltungen Mit Hilfe Von Inkubationsversuchen. Teil 2: Untersuchungen Zur Stickstoff-Und Manganfreisetzung),
W83-03052 5B

NITROGEN COMPOUNDS
Factors Controlling Blue-Green Algae Dominance in a Southwestern Reservoir,
W83-03109 5C

NITROGEN CYCLE
Hydrologic Data of the Lake Cochituate Drainage Basin, Framingham-Natick, Massachusetts,
W83-02989 7C

NITROGEN FIXATION
Factors Controlling Blue-Green Algae Dominance in a Southwestern Reservoir,
W83-03109 5C

NITROGEN GAS BINDING
Wastewater Injection Well Problems, Processes and Standards,
W83-03102 5E

NONPOINT POLLUTION SOURCES
Combined Water-Fertilizer Management to Minimize Non-Point Water Pollution While Achieving High Crop Production,
W83-02907 2I

An Examination of Land Use - Nutrient Export Relationships,
W83-03144 5B

NORTH CAROLINA
Hydrologic and Water Quality Modeling for Instream Flow Strategies,
W83-02927 6C

Development of a Generalized Hydrologic Modelling System,
W83-02946 2E

Use of Geologic and Water Yield Data from Ground Water Based Community Water Systems as a Guide for Ground Water Planning and Management,
W83-03046 4B

NUMERICAL ANALYSIS
Assessment of Economic, Social, and Institutional Impacts of Ground-Water Regulation of the Tillman Terrace Aquifer in Southwestern Oklahoma,
W83-03033 4B

NUTRIENTS
Nutrient-Salinity Relationships in Four Estuaries of the Cape Province, South Africa,
W83-02889 5B

Nutrients and Acid in Rain and Dry Fallout at Fayetteville, Arkansas (1980-1982),
W83-03041 2K

An Examination of Land Use - Nutrient Export Relationships,
W83-03144 5B

OBJECTIVE FUNCTION
Management of Existing Reservoir Systems by Interactive Optimization,
W83-02924 6A

OCEAN DUMPING
Water Quality Improvement in the Firth or Forth: A Discriminant Functional Analysis,
W83-03059 5G

Process Integration in Sludge Management,
W83-03135 5E

OGALLALA AQUIFER
Is the Ogallala Going Dry.
W83-02839 3F

OHIO
Microbiological Aerosols From a Field-Source Wastewater Irrigation System,
W83-02835 5B

Turbidity in the Western Basin of Lake Erie,
W83-03118 2J

OIL INDUSTRY
Physical-Chemical Methods of Treatment for Oil-Containing Effluents,
W83-02855 5D

Sources of Petroleum Hydrocarbon Inputs to the Marine Environment,
W83-02863 5B

OIL SPILL POLLUTION
Hydrocarbon Spills, Their Retention in the Subsurface and Propagation into Shallow Aquifers,
W83-02895 5B

OKLAHOMA
Preliminary Projections of the Effects of Chloride-Control Structures on the Quaternary Aquifer at Great Salt Plains, Oklahoma,
W83-02988 5G

Assessment of Economic, Social, and Institutional Impacts of Ground-Water Regulation of the Tillman Terrace Aquifer in Southwestern Oklahoma,
W83-03033 4B

Irrigation Water Management for Wide-Spaced Furrow Irrigation,
W83-03037 3F

Water Management and Salinity Control in Irrigated Swelling and Shrinking Soils,
W83-03038 3F

Seasonal Patterns and Molecular Weight Variations of Trihalomethane Precursors and Trihalomethane Forming Potential in the Kaw Reservoir,
W83-03108 5B

Factors Controlling Blue-Green Algae Dominance in a Southwestern Reservoir,
W83-03109 5C

The Effects of pH and Redox Potential on the Release of Heavy Metals From Arkansas River Sediments,
W83-03112 5B

OLIGOTROPHIC LAKES
The Impact of Diffuse Atmospheric Nutrient Loading on an Oligotrophic Freshwater Lake in a Developing Urban and Industrial Area (Richards Bay, South Africa),
W83-02850 5C

ONTARIO
Numerical Simulation of Flow and Contaminant Migration at an Extensively Monitored Landfill,
W83-02942 5B

OPEN CHANNELS
Sediment Transport in Alluvial Channels: Rates for Erosion and Deposition of Cohesive Sediments Literature Review and Experimental Design,
W83-03032 2J

OPTIMAL DEVELOPMENT PLANS
Methods for Deriving Operating Rule Curves for Multiple Reservoir Systems,
W83-03094 4A

OPTIMIZATION
Management of Existing Reservoir Systems by Interactive Optimization,
W83-02924 6A

Incremental Dynamic Programming May Yield Nonoptimal Solutions,
W83-02941 4A

Optimal Annual Operation of a Water Supply and Distribution System,
W83-03062 6A

OPTIMUM DEVELOPMENT PLANS
Optimal Annual Operation of a Water Supply and Distribution System,
W83-03062 6A

OREGON
Runoff and Soil Erosion on Frozen Soils in Northeastern Oregon,
W83-02826 2J

Overland Flow From Sloping Land: Effects of Perched Water Tables and Subsurface Drains,
W83-03028 4A

ORGANIC CARBON
The Role of DOC, UV Absorption and TOH Measurements in Water Pollution Control,
W83-02882 5D

Organic Carbon and Oxygen Demand Relationships in Stormflow From Southern Pine Watersheds,
W83-03015 5B

Effect of Ozonation on the Biodegradability and Adsorbability of Specific Organics to be Removed in the 'Biologically Activated Carbon (BAC)' Process,
W83-03107 5D

ORGANIC COMPONDS
Rate Constants of Reactions of Ozone With Organic and Inorganic Compounds in Water--II. Dissociating Organic Compounds,
W83-02951 5F

ORGANIC COMPOUNDS
Removal of Pesticides and Herbicides by Means of Adsorption on Activated Carbon,
W83-02857 5G

Volatilization of Organic Trace Contaminants by Air Stripping for Water Reclamation,
W83-02917 5D

Rate Constants of Reactions of Ozone with Organic and Inorganic Compounds in Water--I. Non-Dissociating Organic Compounds,
W83-02950 5F

Effect of Ozonation on the Biodegradability and Adsorbability of Specific Organics to be Removed in the 'Biologically Activated Carbon (BAC)' Process,
W83-03107 5D

Potential Organometallic Carcinogens in Wastewater Effluents From Coal Gasification Plants,
W83-03110 5B

Modified Stripping Technique for the Analysis of Trace Organics in Water,
W83-03131 5A

ORGANO-HALOGEN POTENTIAL
The Role of DOC, UV Absorption and TOH Measurements in Water Pollution Control,
W83-02882 5D

ORGANOCHLORINE PESTICIDES
Organochlorine and Heavy Metal Residues in Standard Fillets of Coho and Chinook Salmon of the Great Lakes - 1980,
W83-02843 5C

ORGANOMETALLIC COMPLEXES
Potential Organometallic Carcinogens in Wastewater Effluents From Coal Gasification Plants,
W83-03110 5B

OUTFALL
Water Quality Improvement in the Firth or Forth: A Discriminant Functional Analysis,
W83-03059 5G

OUTLETS
River and Watercourse Crossings and Lake Outlets With HDPE Pipes (Fluss- und Gewasserkreuzungen Sowie Seeauslaufleitungen Mit Rohren Aus HDPE),
W83-02803 8G

OVERLAND FLOW
Overland Flow From Sloping Land: Effects of Perched Water Tables and Subsurface Drains,
W83-03028 4A

OXIDATION
Hygienic Evaluation of Water Polluted by Pesticides Entering Water Bodies in Surface Runoff (Gigienicheskaya Otsenka Vody, Zagryaznennoi Nekotorymi Pestitsidami Pri Postuplenii Ikh V Vodoem S Poverkhnostnym Stokom),
W83-03017 5C

OXIDATION LAGOONS
Wastewater Stabilization Lagoon Effluent Upgrading With Modified Intermittent Sand Filters,
W83-02902 5D

OXIDATION-REDUCTION POTENTIAL
The Effects of pH and Redox Potential on the Release of Heavy Metals From Arkansas River Sediments,
W83-03112 5B

OXYGEN DEPLETION
Lake Erie Oxygen Depletion Controversy,
W83-02824 5G

OXYGEN REQUIREMENTS
Metabolism of California Stream Fishes,
W83-02944 5C

OZONATION
Rate Constants of Reactions of Ozone with Organic and Inorganic Compounds in Water--I. Non-Dissociating Organic Compounds,
W83-02950 5F

Rate Constants of Reactions of Ozone With Organic and Inorganic Compounds in Water--II. Dissociating Organic Compounds,
W83-02951 5F

Comparative Inactivation of Six Enteroviruses by Ozone,
W83-03068 5F

Recent Developments in Water Treatment in France,
W83-03069 5F

Effect of Ozonation on the Biodegradability and Adsorbability of Specific Organics to be Removed in the 'Biologically Activated Carbon (BAC)' Process,
W83-03107 5D

Seasonal Patterns and Molecular Weight Variations of Trihalomethane Precursors and Trihalomethane Forming Potential in the Kaw Reservoir,
W83-03108 5B

Granular Activated Carbon and Preozonated Granular Activated Carbon Treatment for Biologically and Physically-Chemically Treated Wastewater Effluents,
W83-03128 5D

PARASITES
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W83-02887 5B

PATH OF POLLUTANTS
Nutrient-Salinity Relationships in Four Estuaries of the Cape Province, South Africa,
W83-02889 5B

Statewide Evaluation of Trace Element Accumulation From Long Term Disposal of Waste Water,
W83-02892 3C

Hydrocarbon Spills, Their Retention in the Subsurface and Propagation into Shallow Aquifers,
W83-02895 5B

Transport Modeling of an Agricultural Pesticide, Phase I,
W83-03043 5B

Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Water with the Aid of Incubation Experiments. Part 1: Determination of Rates of Phosphorus and Iron Release (Bestimmung von Nahrstoff- und Metall-Freisetzungsraten aus Sedimenten Umweltbelasteter Fliessgewasserstauhaltungen mit Hilfe von Inkubationsversuchen. Teil 1: Bestimmung von Phosphor- und Eisenfreisetzungsraten),
W83-03053 5B

Toxic Substance Models for the Upper Mississippi and Missouri Rivers,
W83-03114 5B

PEAK LAG METHOD
Reaeration Rate Estimation Using the Lag in Dissolved Oxygen Concentration,
W83-02914 5A

PENNSYLVANIA
Nature and Extent of Acid Snowpacks in Pennsylvania,
W83-02943 2C

PERCH
Changes in Abundance and Growth Characteristics of White Perch From the Mouth of the Bay of Quinte,
W83-02808 6G

PERCHED WATER TABLE
Overland Flow From Sloping Land: Effects of Perched Water Tables and Subsurface Drains,
W83-03028 4A

PERMETHRIN
The Influence of Adsorption on Glass, pH and Temperature on the Disappearance of Permethrin in Aqueous Systems,
W83-03057 5B

PESTICIDE RESIDUES
Organochlorine and Heavy Metal Residues in Standard Fillets of Coho and Chinook Salmon of the Great Lakes - 1980,
W83-02843 5C

A Saponification Procedure for the Determination of Some Chlorinated Hydrocarbons in Fish,
W83-03077 5A

PESTICIDES
Lake Ontario Sediment-Mirex Relationships,
W83-02823 5B

Hygienic Evaluation of Water Polluted by Pesticides Entering Water Bodies in Surface Runoff (Gigienicheskaya Otsenka Vody, Zagryaznennoi Nekotorymi Pestitsidami Pri Postuplenii Ikh V Vodoem S Poverkhnostnym Stokom),
W83-03017 5C

Transport Modeling of an Agricultural Pesticide, Phase I,
W83-03043 5B

The Influence of Adsorption on Glass, pH and Temperature on the Disappearance of Permethrin in Aqueous Systems,
W83-03057 5B

PESTICIDES RESIDUES
The Influence of Sex, Size, and Season on Mirex Levels Within Selected Tissues of Lake Ontario Salmon,
W83-02841 5C

PHOSPHATES
Soluble Reactive Phosphorus Measurements in Lake Michigan: Causes of Method-Specific Differences,
W83-02821 5A

PHOSPHORUS
The Measurement of Total Phosphorus in Waste Water (Le Dosage du Phosphore Total Dans Les Eaux Usees),
W83-02816 5A

Soluble Reactive Phosphorus Measurements in Lake Michigan: Causes of Method-Specific Differences,
W83-02821 5A

Lake Erie Oxygen Depletion Controversy,
W83-02824 5G

Effectiveness of Treatment to Meet Phosphorus Objectives in the Great Lakes,
W83-02830 5G

Improving Design of a Domestic Waste Disposal System Using an Unsaturated Flow Model and Phosphorus Adsorption,
W83-02900 5D

Pollution Potential Ranking of Barnyards for Priority Watershed Planning,
W83-02915 5G

A Kinetic Model of Steady State Phosphorus Fixation in a Batch Reactor--IV,
W83-02952 5D

Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Water with the Aid of Incubation Experiments. Part 1: Determination of Rates of Phosphorus and Iron Release (Bestimmung von Nahrstoff- und Metall-Freisetzungsraten aus Sedimenten Umweltbelasteter Fliessgewasserstauhaltungen mit Hilfe von Inkubationsversuchen. Teil 1: Bestimmung von Phosphor- und Eisenfreisetzungsraten),
W83-03053 5B

Soluble Reactive Phosphorus Measurements in Lake Michigan: Filtration Artifacts,
W83-03084 5A

PHOSPHORUS COMPOUNDS
Hydrologic Data of the Lake Cochituate Drainage Basin, Framingham-Natick, Massachusetts,
W83-02989 7C

Factors Controlling Blue-Green Algae Dominance in a Southwestern Reservoir,
W83-03109 5C

PHOSPHORUS REMOVAL
An Integrated Low Cost System for Treatment of Potato Processing Wasterwater Incorporating Anaerobic Fermentation and Phosphorus Removal,
W83-03124 5D

Alum Control of Internal Phosphorus Loading in a Shallow Lake,
W83-03140 5G

PHOTOPLANKTON
The Striped Bass Decline in the San Francisco Bay-Delta Estuary,
W83-02919 5C

PHREATOPHYTES
Evapotranspiration Before and After Clearing Phreatophytes, Gila River Flood Plain, Graham County, Arizona,
W83-02966 2D

PHYSIOCHEMICAL TREATMENT
Physical-Chemical Methods of Treatment for Oil-Containing Effluents,
W83-02855 5D

PHYTOPLANKTON
A Ten-year Study of Phytoplankton Biomass and Composition in the Nanticoke Region of Long Point Bay, Lake Erie,
W83-03080 2H

Factors Controlling Blue-Green Algae Dominance in a Southwestern Reservoir,
W83-03109 5C

PIPES
River and Watercourse Crossings and Lake Outlets With HDPE Pipes (Fluss- und Gewasserkreuzungen Sowie Seeauslaufleitungen Mit Rohren Aus HDPE),
W83-02803 8G

Corrosion Behavior of Passivatable Stainless Steel Under Reducing Conditions with Simultaneous Abrasive Stress (Das Korrosionsverhalten Passivierbarer Nichtrostender Stahle in Wassern Unter Reduzierenden Bedingungen Bei Gleichzeitiger Abrasiver Beanspruchung),
W83-03047 8G

PLANKTON
Sorption and Sedimentation of Zn and Cd by Seston in Southern Lake Michigan,
W83-03083 5B

PLANNING
The Role of Consultants,
W83-02860 5D

Scale-Up Problems,
W83-02861 5D

Mathematical Modelling of Estuaries and Coastal Waters,
W83-02867 2L

Theme 3: The Economics of Water Pollution Control and Research: Introduction by the Session Convenor,
W83-02869 6B

Obtaining an Analytical Grasp of Water Distribution Systems,
W83-03066 5F

Ten Ecosystem Approaches to the Planning and Management of the Great Lakes,
W83-03082 6A

PLASTICS
River and Watercourse Crossings and Lake Outlets With HDPE Pipes (Fluss- und Gewasserkreuzungen Sowie Seeauslaufleitungen Mit Rohren Aus HDPE),
W83-02803 8G

POLITICAL ASPECTS
Assessment of Economic, Social, and Institutional Impacts of Ground-Water Regulation of the Tillman Terrace Aquifer in Southwestern Oklahoma,
W83-03033 4B

POLLUTANT IDENTIFICAITON
Trends in Lake Ontario Surveillance Parameters, 1974-1980,
W83-02840 2H

POLLUTANT IDENTIFICATION
The Measurement of Total Phosphorus in Waste Water (Le Dosage du Phosphore Total Dans Les Eaux Usees),
W83-02816 5A

Determination of the Colour of Water and Waste Water (Bestimmung der Farbigkeit Von Wassern),
W83-02819 5A

Soluble Reactive Phosphorus Measurements in Lake Michigan: Causes of Method-Specific Differences,
W83-02821 5A

The Role of DOC, UV Absorption and TOH Measurements in Water Pollution Control,
W83-02882 5D

A Simplified Scheme for the Analysis of Pollutants in Groundwater and Leachates Contaminated by Hazardous Chemicals,
W83-02904 5A

The Measurement of Complexation Capacity and Conditional Stability Constants for Ligands in Natural Waters,
W83-02957 5A

A Saponification Procedure for the Determination of Some Chlorinated Hydrocarbons in Fish,
W83-03077 5A

Soluble Reactive Phosphorus Measurements in Lake Michigan: Filtration Artifacts,
W83-03084 5A

Artifacts and Losses in the Sampling of Chlorinated Waters by XAD Adsorption,
W83-03104 5A

Identification of Total and Biologically Sensitive Forms of Toxic Metal Inputs to an Urban Affected River,
W83-03105 5A

Modified Stripping Technique for the Analysis of Trace Organics in Water,
W83-03131 5A

Maximum Contaminant Levels for Toxic Substances in Water: A Statistical Approach,
W83-03145 5A

POLLUTION INDEX
Computation of the Index of Pollution Caused by Heavy Metals in River Sediment,
W83-03049 5B

POLLUTION TAXES
Guidelines for the Reduction of Wastewater Tax (Hinweise zur Reduzierung Der Abwasserabgabe),
W83-02801 6F

POLYMERS
Field Tests Underwqy for Three New Agricultural Polymers.
W83-03129 3F

POND FERTILIZATION
Prediction of the Response of Pond Biota to Animal Waste Fertilization,
W83-03103 5C

POPULATION DYNAMICS
An Ecological Study of Ozark Streams,
W83-02916 6G

POROSITY
Water Diffusivity of a Field Soil,
W83-02995 2G

Water Adsorption and Swelling of Clay Minerals in Soil Systems,
W83-02996 2G

Bacterial Utilization of Simple Alcohols and Their Influence on Saturated Hydraulic Conductivity,
W83-03014 2G

POROUS MEDIA
Derivation of Vertically Averaged Equations Describing Multiphase Flow in Porous Media,
W83-02930 2F

Contaminant Transport in Fractured Porous Media: Analytical Solutions for a System of Parallel Fractures,
W83-02933 5B

POTABLE WATER
Sanitary Problems in Relationship With Tap Water Distributed in New or Recent Buildings of Paris (Problems Sanitaires Poses A Paris Par L'Eau Potable Dans Les Immeubles Neufs Ou Recents),
W83-02844 5F

POWERPLANTS
Impact of Power Plant Entrainment of Ichthyoplankton on Juvenile Recruitment of Four Fishes in Western Lake Erie in 1975-77,
W83-03075 5C

PRETREATMENT
The Application of Pretreatment Procedures to Limit Membrane Fouling in Reverse Osmosis Reclamation of Secondary Sewage Effluents,
W83-02849 5D

PRINCIPAL COMPONENT ANALYSIS
Factors Controlling Blue-Green Algae Dominance in a Southwestern Reservoir,
W83-03109 5C

PRIORITY POLLUTANTS
Maximum Contaminant Levels for Toxic Substances in Water: A Statistical Approach,
W83-03145 5A

PROBABILISTIC PROCESSES
Management of Existing Reservoir Systems by Interactive Optimization,
W83-02924 6A

PROCESS CONTROL
Team Effort Solves Operational Problems,
W83-02805 5D

PROPANOL
Bacterial Utilization of Simple Alcohols and Their Influence on Saturated Hydraulic Conductivity,
W83-03014 2G

PROPERTY VALUE
Benefits of Pollution Control on Massachusetts' Housatonic River: A Hedonic Pricing Approach,
W83-03141 6B

PROTEINS
A System Developed for the Treatment of Tanning and Other Proteinaceous Effluents,
W83-02853 5D

Production of Algal Protein in Raw Sewage,
W83-02856 3C

PUBLIC HEALTH
The Health Significance of Viruses in Water.
W83-02959 5F

Drinking Water and Legionnaires' Disease,
W83-03067 5F

Comparative Inactivation of Six Enteroviruses by Ozone,
W83-03068 5F

The Relationship of Minerals Commonly Found in Drinking Water to Atherosclerosis and Hypertension in Pigeons,
W83-03081 5C

Evaluating Potential Health Risks of Consuming Reused Water,
W83-03086 5C

Toxicological Problems Associated with Alternative Methods of Disinfection,
W83-03087 5C

Exposure to Microbial Aerosols From Activated Sludge Treatment,
W83-03097 5D

PUBLIC OPINION
Assessment of Economic, Social, and Institutional Impacts of Ground-Water Regulation of the Tillman Terrace Aquifer in Southwestern Oklahoma,
W83-03033 4B

PULP AND PAPER INDUSTRY
Modified Stripping Technique for the Analysis of Trace Organics in Water,
W83-03131 5A

PUMPAGE
Application of Linear Systems Theory and Linear Programming to Ground Water Management in Kansas,
W83-03142 4B

PUMPED STORAGE
The Future of Underground Pumped Hydro.
W83-03012 8A

RADIATION
Radon, Water, and Air Pollution: Risks and Control,
W83-03031 5C

RADIOACTIVE WASTE DISPOSAL
Geologic and Well-Construction Data for the H-7 Borehole Complex Near the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-02977 4B

RADIOACTIVITY EFFECTS
Radon, Water, and Air Pollution: Risks and Control,
W83-03031 5C

RADIOISOTOPES
Radium, Thorium and Radioactive Lead Isotopes in Groundwaters: Application to the in Situ Determination of Adsorption-Desorption Rate Constants and Retardation Factors,
W83-02937 2K

RADON
Radon, Water, and Air Pollution: Risks and Control,
W83-03031 5C

RAIN
Nutrients and Acid in Rain and Dry Fallout at Fayetteville, Arkansas (1980-1982),
W83-03041 2K

RAINFALL
Seasonal Patterns in Extreme 1-Hour Rainfalls,
W83-02932 2B

RAINFALL IMPACT
A Numerical Study of Raindrop Impact Phenomena: The Rigid Case,
W83-03029 2J

RAINFALL-RUNOFF RELATIONSHIPS
Hydrological and Environmental Controls on Water Management in Semiarid Urban Areas -- Phase II,
W83-02918 4D

RAW WASTEWATER
Production of Algal Protein in Raw Sewage,
W83-02856 3C

REAERATION COEFFICIENT
Reaeration Rate Estimation Using the Lag in Dissolved Oxygen Concentration,
W83-02914 5A

RECHARGE MODELING
Modeling Direct Recharge of Surficial Aquifers,
W83-03101 2F

RECHARGE WELLS
Well Recharge in Idealized Rectangular Aquifers,
W83-03056 4B

RECLAIMED WATER
Evaluating Potential Health Risks of Consuming Reused Water,
W83-03086 5C

RECREATION
Biological and Recreational Aspects of Water Level Management for Clear Lake, Iowa,
W83-03036 6G

RECYCLING
The Performance of an Ultrafiltration Pilot-Plant for the Closed Loop Recycling of Textile Desizing Effluents,
W83-03123 5D

REGIONAL ANALYSIS
Comparing Methods of Hydrologic Regionalization,
W83-03146 7C

REGRESSION ANALYSIS
Techniques for Estimating Flood Discharges for Unregulated Streams in New Mexico,
W83-02981 2E

Comparing Methods of Hydrologic Regionalization,
W83-03146 7C

REMOTE SENSING
Soil Moisture Variation Patterns Observed in Hand County, South Dakota,
W83-03138 2G

RESERVOIR DESIGN
Optimal Design of Small Reservoir Systems,
W83-02836 3B

RESERVOIR MANAGEMENT
Methods for Deriving Operating Rule Curves for Multiple Reservoir Systems,
W83-03094 4A

RESERVOIR OPERATION
Management of Existing Reservoir Systems by Interactive Optimization,
W83-02924 6A

Agricultural Vs. Hydropower Tradeoffs in the Operation of the High Aswan Dam,
W83-02934 6B

Reservoir Capacity Conservation (Conservazione Della Capacita Utile Nei Laghi Artificiali),
W83-02953 8A

RESERVOIR OPERATIONS
Methods for Deriving Operating Rule Curves for Multiple Reservoir Systems,
W83-03094 4A

RESERVOIR STORAGE
Significance on the New Large Water Reservoir Schonbühl and Its Consequences on the Landeswasserversorgung Stuttgart (Die Bedeutung Des Neuen Grossbehalters Schonbuhl Fur Die Landeswasserversorgung Stuttgart),
W83-02963 8A

Storage Requirements to Sustain Gross Reservoir Outflow From Small Basins in Kansas,
W83-02992 2E

Evaluation of Rapid Reservoir Storage-Yield Procedures,
W83-03061 4A

RESERVOIRS
Behavior of Fishes in the Desaulniers River Basin After Filling of the Desaulniers Reservoir (Comportement Des Poissons Du Bassin De La Riviere Desaulniers Apres Le Remplissage Du Reservoir Desaulniers),
W83-03050 6G

Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Waters with the aid of Incubation Experiments. Part 2: Investigations on Nitrogen and Manganese Release (Bestimmung Von Nahrstoff- Und Metallfreisetzungsraten Aus Sedimenten Unweltbelasteter Fliessgewasserstau-Haltungen Mit Hilfe Von Inkubationsversuchen. Teil 2: Untersuchungen Zur Stickstoff-Und Manganfreisetzung),
W83-03052 5B

Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Water with the Aid of Incubation Experiments. Part 1: Determination of Rates of Phosphorus and Iron Release (Bestimmung von Nahrstoff- und Metall-Freisetzungsraten aus Sedimenten Umweltbelasteter Fliessgewasserstauhaltungen mit Hilfe von Inkubationsversuchen. Teil 1: Bestimmung von Phosphor- und Eisenfreisetzungsraten),
W83-03053 5B

RESIDENTIAL WATER USE
Price, Socioeconomic, and Climatic Influences on Residential Water Use in Southern Arizona,
W83-02894 6D

RESIDUAL CHLORINE
A Theoretical and Experimental Investigation of the Dynamics of Breakpoint Chlorination in Dispersed Flow Reactors,
W83-02926 5F

RESOURCES DEVELOPMENT
Geothermal Resources in the Northwestern Border (Recursos Geothermicos en la Frontera Noroccidental),
W83-03021 2F

REVERSE OSMOSIS
The Application of Pretreatment Procedures to Limit Membrane Fouling in Reverse Osmosis Reclamation of Secondary Sewage Effluents,
W83-02849 5D

Energy Recovery From the Reject Brine of Reverse Osmosis Systems,
W83-03113 3A

RHINE RIVER
Contents of Metals and Suspended Solids in the Rhine (Metallgehalt und Schwebstoffgehalt im Rhein),
W83-02813 5B

RICE
Water Requirements for Flooded Rice Cultivation,
W83-03002 3F

RIO GRANDE RIVER
Surface Water Availability and Future Demand along the Border from Juarez to Matamoros (Disponibilidad de Aguas Superficiales Y su Demanda Futuro a lo Largo De la Franja Fronteriza Desde Ciudad Juarez, Chihuahua, Hasta Matamoros, Tamaulipas),
W83-03022 6E

RISK
Methods for Deriving Operating Rule Curves for Multiple Reservoir Systems,
W83-03094 4A

RIVER BASINS
Hydrology, Hydraulics, and Sediment Transport, Kankakee and Iroquois Rivers,
W83-02921 2J

Sources, Sinks, and Storage of River Sediment in the Atlantic Drainage of the United States,
W83-03117 2J

RIVER FLOW
Hydrology, Hydraulics, and Sediment Transport, Kankakee and Iroquois Rivers,
W83-02921 2J

RURAL AREAS
Building Water and Sanitation Projects in Rural Guatemala,
W83-03071 5F

SAFETY
Safety Factors for Probabilistic Slope Design,
W83-03090 8D

SALINE LAKES
Preliminary Projections of the Effects of Chloride-Control Structures on the Quaternary Aquifer at Great Salt Plains, Oklahoma,
W83-02988 5G

SALINE SOILS
Salinity Investigations in West Salt Creek, Colorado,
W83-02925 5B

SALINE WATER
Infiltration as Affected by Long-Term Use of Sodic-Saline Water for Irrigation,
W83-03016 3C

Soil Pore Structural Stability and Irrigation Water Quality: III. Evaluation of Soil Stability and Crop Yield in Relation to Salinity and Sodicity,
W83-03025 2G

Soil Pore Structural Stability and Irrigation Water Quality: II. Sodium Stability Data,
W83-03026 2G

Soil Pore Structural Stability and Irrigation Water Quality: I. Empirical Sodium Stability Model,
W83-03027 2G

Runoff and Water Quality From Three Soil Landform Units on Mancos Shale,
W83-03150 2J

SALINITY
Defining Cost-Effective Salinity Control Programs,
W83-02829 5G

Nutrient-Salinity Relationships in Four Estuaries of the Cape Province, South Africa,
W83-02889 5B

Salinity Investigations in West Salt Creek, Colorado,
W83-02925 5B

SALINITY CONTROL
Defining Cost-Effective Salinity Control Programs,
W83-02829 5G

Mineralization Problems in the PWV Complex - The Identification of Viable Solutions by Means of a Suite of Mathematical Models,
W83-02881 5G

Water Management and Salinity Control in Irrigated Swelling and Shrinking Soils,
W83-03038 3F

SALMON
The Influence of Sex, Size, and Season on Mirex Levels Within Selected Tissues of Lake Ontario Salmon,
W83-02841 5C

Organochlorine and Heavy Metal Residues in Standard Fillets of Coho and Chinook Salmon of the Great Lakes - 1980,
W83-02843 5C

SALTS
Salinity and Boron Control Under High-Frequency Low-Volume Irrigation,
W83-02908 5B

Chemistry of South Polar Snow,
W83-03119 2K

SAMPLING
The Role of DOC, UV Absorption and TOH Measurements in Water Pollution Control,
W83-02882 5D

Spatial Variability of Surface Temperature Along Two Transects of a Bare Soil,
W83-02940 2G

Soil Moisture Variation Patterns Observed in Hand County, South Dakota,
W83-03138 2G

SAN FRANCISCO BAY
On Lagrangian Residual Currents With Applications in South San Francisco Bay, California,
W83-02928 2L

SAND
Dam and River Sand-Drifting Inspection (La Bathymetrie--Technique De Surveillance De L'Ensablement Des Fleuves Et Des Retenues),
W83-02961 2J

SAPONIFICATION
A Saponification Procedure for the Determination of Some Chlorinated Hydrocarbons in Fish,
W83-03077 5A

SCOTLAND
Water Quality Improvement in the Firth or Forth: A Discriminant Functional Analysis,
W83-03059 5G

SEASONAL VARIATION
Seasonal Patterns in Extreme 1-Hour Rainfalls,
W83-02932 2B

SEASONAL VARIATIONS
Seasonal Patterns and Molecular Weight Variations of Trihalomethane Precursors and Trihalomethane Forming Potential in the Kaw Reservoir,
W83-03108 5B

SEDIMENT
Effect of Atmospheric Sulfur Pollutants Derived from Acid Precipitation on the Benthic Dynamics of Lakes,
W83-03093 5C

SEDIMENT DISCHARGE
Reservoir Capacity Conservation (Conservazione Della Capacita Utile Nei Laghi Artificiali),
W83-02953 8A

SEDIMENT TRANSPORT
Hydrology, Hydraulics, and Sediment Transport, Kankakee and Iroquois Rivers,
W83-02921 2J

Effects of Aggradation and Degradation on Riffle-Pool Morphology in Natural Gravel Channels, Northwestern California,
W83-02936 2J

Organic Carbon and Oxygen Demand Relationships in Stormflow From Southern Pine Watersheds,
W83-03015 5B

Sediment Transport in Alluvial Channels: Rates for Erosion and Deposition of Cohesive Sediments Literature Review and Experimental Design,
W83-03032 2J

Transport of Heavy Metals on Suspended Sediments Under High Flow Conditions in a Mineralized Region of Wales,
W83-03048 5B

Mobilization, Movement and Deposition of Active Subaerial Sediment Flows, Matanuska Glacier, Alaska,
W83-03116 2J

Sources, Sinks, and Storage of River Sediment in the Atlantic Drainage of the United States,
W83-03117 2J

Turbidity in the Western Basin of Lake Erie,
W83-03118 2J

Runoff and Water Quality From Three Soil Landform Units on Mancos Shale,
W83-03150 2J

SEDIMENT YIELD
A Study of the Bed-Load Yield From a Watershed,
W83-03096 2J

SEDIMENTATION
Settling Velocity of Natural Particles,
W83-02939 2J

Sedimentation and its Control in Nadis in the Indian Arid Zone - a Case Study,
W83-03133 2J

SEDIMENTATION RATES
Soil Conservation in the Coon Creek Basin, Wisconsin,
W83-02827 4D

Sediment Transport in Alluvial Channels: Rates for Erosion and Deposition of Cohesive Sediments Literature Review and Experimental Design,
W83-03032 2J

SEDIMENTS
Calcium Carbonate in Postglacial Lake Erie Sediment,
W83-02809 2J

Mass Balance Modeling of Heavy Metals in Saginaw Bay, Lake Huron,
W83-02820 5B

Vertical Distribution of Profundal Benthos in Lake Superior Sediments,
W83-02822 2H

Lake Ontario Sediment-Mirex Relationships,
W83-02823 5B

Retention of Benthic Invertebrates With Different Sieving Techniques,
W83-02825 2H

Computation of the Index of Pollution Caused by Heavy Metals in River Sediment,
W83-03049 5B

The Effects of pH and Redox Potential on the Release of Heavy Metals From Arkansas River Sediments,
W83-03112 5B

SEEPAGE CONTROL
Overland Flow From Sloping Land: Effects of Perched Water Tables and Subsurface Drains,
W83-03028 4A

SEMI-ARID AREAS
Hydrological and Environmental Controls on Water Management in Semiarid Urban Areas -- Phase II,
W83-02918 4D

SENSITIVITY
Application of Numerical Simulation Techniques to Floodplain Management,
W83-02893 2E

SENSITIVITY ANALYSIS
Safety Factors for Probabilistic Slope Design,
W83-03090 8D

SETTLING VELOCITY
Settling Velocity of Natural Particles,
W83-02939 2J

SEWAGE EFFLUENTS
Wastewater Stabilization Lagoon Effluent Upgrading With Modified Intermittent Sand Filters,
W83-02902 5D

SEWAGE LAGOONS
Wastewater Stabilization Lagoon Effluent Upgrading With Modified Intermittent Sand Filters,
W83-02902 5D

SHALES
Salinity Investigations in West Salt Creek, Colorado,
W83-02925 5B

SHALLOW WELLS
Microbial Quality of Water in Old Wells and the Public Water Distribution System in the U. S. Virgin Islands,
W83-03098 5F

SHEAR STRESS
Wave Action and Bottom Shear Stresses in Lake Erie,
W83-03073 2H

SHORELINE PROTECTION
Shore Protection in the Town of Stoney Creek, Southwest Lake Ontario, 1934-1979: Historical Changes and Durability of Structures,
W83-02842 4D

SIEVE ANALYSIS
Retention of Benthic Invertebrates With Different Sieving Techniques,
W83-02825 2H

SIMULATION
Application of Numerical Simulation Techniques to Floodplain Management,
W83-02893 2E

SIMULATION ANALYSIS
Management of Existing Reservoir Systems by Interactive Optimization,
W83-02924 6A

Transport Modeling of an Agricultural Pesticide, Phase I,
W83-03043 5B

Modeling Direct Recharge of Surficial Aquifers,
W83-03101 2F

SLOPE PROTECTION
Safety Factors for Probabilistic Slope Design,
W83-03090 8D

SLOPE STABILITY
Safety Factors for Probabilistic Slope Design,
W83-03090 8D

SLUDGE
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W83-02887 5B

SLUDGE DIGESTION
Thermal Pretreatment of Sludges--A Field Demonstration,
W83-02831 5E

Mortality Patterns of Indicator Organisms During Aerobic Digestion,
W83-02834 5E

Simultaneous Pasteurization - Digestion (SPD-Process),
W83-03125 5D

SLUDGE DISPOSAL
New Method Simplifies Sludge Disposal.
W83-03070 5E

Process Integration in Sludge Management,
W83-03135 5E

SLUDGE FILTERS
Theoretical and Experimental Study of Factors Affecting Capillary Suction Time (CST),
W83-02955 5D

SLUDGE HANDLING
Aerobic Thermophilic Stabilization of Sludge Versus Anaerobic Digestion and Other Kinds of Sludge Treatment at Middle-Sized Plants with Respect to Power Conservation and Economy,
W83-03121 5D

SLUDGE TREATMENT
Laboratory Study of Dynamic-State Control of Activated Sludge Processes,
W83-02910 5D

SMALL WATERSHEDS
Aquatic Biology in Nederlo Creek, Southwestern Wisconsin,
W83-02978 6G

Storage Requirements to Sustain Gross Reservoir Outflow From Small Basins in Kansas,
W83-02992 2E

SNOW
Chemical Composition of Bulk Precipitation in the North-Central and Northeastern United States, December 1980 Through February 1981,
W83-02968 2K

Chemistry of South Polar Snow,
W83-03119 2K

SNOWMELT
Runoff and Soil Erosion on Frozen Soils in Northeastern Oregon,
W83-02826 2J

Toxicity Assessment of Snowmelt Water Runoff in an Urban Area (Toxicite Des Eaux De Ruissellement De La Fonte De Neige En Milieu Urbain),
W83-02958 5C

Floods in Maine, April-May 1979,
W83-02983 2E

SNOWPACKS
Nature and Extent of Acid Snowpacks in Pennsylvania,
W83-02943 2C

SODIUM COMPOUNDS
Investigations on the Elimination Efficiency of Metal Hydroxide Flocs Which are Made Hydrophobic by Precipitation in the Presence of Sodium Stearate (Untersuchungen Uber Die Eliminationswirkung Hydrophobierter Metalloxidhydrat-Flocken),
W83-02812 5D

SOIL ABSORPTION CAPACITY
Water Adsorption and Swelling of Clay Minerals in Soil Systems,
W83-02996 2G

SOIL CONSERVATION
Soil Conservation in the Coon Creek Basin, Wisconsin,
W83-02827 4D

SOIL CONTAMINATION
Removal of Pesticides and Herbicides by Means of Adsorption on Activated Carbon,
W83-02857 5G

SOIL DENSITY
Calibration and Field Testing of a Two-Probe Gamma Gauge,
W83-02964 7B

SOIL EROSION
Runoff and Soil Erosion on Frozen Soils in Northeastern Oregon,
W83-02826 2J

A Numerical Study of Raindrop Impact Phenomena: The Rigid Case,
W83-03029 2J

Uruguay's Save Our Soils Campaign.
W83-03134 4D

SOIL MANAGEMENT
Uruguay's Save Our Soils Campaign.
W83-03134 4D

SOIL PHYSICAL PROPERTIES
Water Diffusivity of a Field Soil,
W83-02995 2G

SOIL PHYSICS
Absorption of Water by Soil: The Effect of a Surface Crust,
W83-02997 2G

SOIL PROFILES
Salinity and Boron Control Under High-Frequency Low-Volume Irrigation,
W83-02908 5B

SOIL PROPERTIES
Soil Hydraulic Properties as Stochastic Processes: II. Errors of Estimates in a Heterogeneous Field,
W83-02999 2G

Temperature Dependence of Unsaturated Hydraulic Conductivity of Two Soils,
W83-03000 2G

SOIL SALINITY
Water Management and Salinity Control in Irrigated Swelling and Shrinking Soils,
W83-03038 3F

SOIL STABILITY
Soil Pore Structural Stability and Irrigation Water Quality: III. Evaluation of Soil Stability and Crop Yield in Relation to Salinity and Sodicity,
W83-03025 2G

Soil Pore Structural Stability and Irrigation Water Quality: II. Sodium Stability Data,
W83-03026 2G

Soil Pore Structural Stability and Irrigation Water Quality: I. Empirical Sodium Stability Model,
W83-03027 2G

SOIL SURFACE
The Effect of Turfgrass Thatch on Water Infiltration Rates,
W83-03023 4A

SOIL SURFACES
Spatial Variability of Surface Temperature Along Two Transects of a Bare Soil,
W83-02940 2G

Absorption of Water by Soil: The Effect of a Surface Crust,
W83-02997 2G

Infiltration as Affected by Long-Term Use of Sodic-Saline Water for Irrigation,
W83-03016 3C

SOIL TEMPERATURE
Spatial Variability of Surface Temperature Along Two Transects of a Bare Soil,
W83-02940 2G

SOIL TREATMENT
Field Tests Underwqy for Three New Agricultural Polymers.
W83-03129 3F

SOIL WATER
Test of an Equation for Evaporation From Bare Soil,
W83-02929 2G

On Subsurface Stormflow: Predictions with Simple Kinematic Theory for Saturated and Unsaturated Flows,
W83-02931 2G

Spatial Variability of Surface Temperature Along Two Transects of a Bare Soil,
W83-02940 2G

Hydrodynamic Dispersion During Unsteady, Unsaturated Water Flow in a Clay Soil,
W83-03001 2G

Soil Moisture Variation Patterns Observed in Hand County, South Dakota,
W83-03138 2G

SOIL-WATER-PLANT RELATIONSHIPS
A Water Use Comparison Between Corn and Sunflower,
W83-02828 2I

Evaporative Flux From Wheat and Fallow in a Semiarid Climate,
W83-02965 2D

SOIL WATER RECHARGE
Midseason Soil Water Recharge for Corn in the Northwestern Corn Belt,
W83-02890 2G

SOIL WATER STORAGE
Midseason Soil Water Recharge for Corn in the Northwestern Corn Belt,
W83-02890 2G

SOLAR HEATING
Solar Heating of Wastewater Stabilization Ponds,
W83-03100 5D

SOLAR RADIATION
Weather and Consumptive Use in the Bear River Basin, Idaho During 1982,
W83-02911 2D

SOLID WASTES
Waste From the Water Treatment Plant at Alton and Its Impact on the Mississippi River,
W83-02920 5E

SOLUTE TRANSPORT
Contaminant Transport in Fractured Porous Media: Analytical Solutions for a System of Parallel Fractures,
W83-02933 5B

Radium, Thorium and Radioactive Lead Isotopes in Groundwaters: Application to the in Situ Determination of Adsorption-Desorption Rate Constants and Retardation Factors,
W83-02937 2K

Numerical Simulation of Flow and Contaminant Migration at an Extensively Monitored Landfill,
W83-02942 5B

Hydrodynamic Dispersion During Unsteady, Unsaturated Water Flow in a Clay Soil,
W83-03001 2G

SORPTION
Sorption and Sedimentation of Zn and Cd by Seston in Southern Lake Michigan,
W83-03083 5B

SOUTH AFRICA
The Application of Pretreatment Procedures to Limit Membrane Fouling in Reverse Osmosis Reclamation of Secondary Sewage Effluents,
W83-02849 5D

The Impact of Diffuse Atmospheric Nutrient Loading on an Oligotrophic Freshwater Lake in a Developing Urban and Industrial Area (Richards Bay, South Africa),
W83-02850 5C

A System Developed for the Treatment of Tanning and Other Proteinaceous Effluents,
W83-02853 5D

Production of Algal Protein in Raw Sewage,
W83-02856 3C

Funding Water Pollution Control in South Africa,
W83-02870 6F

Mineralization Problems in the PWV Complex - The Identification of Viable Solutions by Means of a Suite of Mathematical Models,
W83-02881 5G

A Chemical Investigation of a Marine Sewage Outfall,
W83-02888 5B

Nutrient-Salinity Relationships in Four Estuaries of the Cape Province, South Africa,
W83-02889 5B

Soil Pore Structural Stability and Irrigation Water Quality: II. Sodium Stability Data,
W83-03026 2G

SOUTH CAROLINA
Updip Delineation of the Tertiary Limestone Aquifer, South Carolina,
W83-02896 2F

Techniques for Estimating Magnitude and Frequency of Floods in South Carolina,
W83-02979 2E

SOUTH DAKOTA
Soil Moisture Variation Patterns Observed in Hand County, South Dakota,
W83-03138 2G

SPATIAL DISTRIBUTION
Soil Hydraulic Properties as Stochastic Processes: II. Errors of Estimates in a Heterogeneous Field,
W83-02999 2G

SPECIATION
The Measurement of Complexation Capacity and Conditional Stability Constants for Ligands in Natural Waters,
W83-02957 5A

SPECIES ABUNDANCE DISTRIBUTIONS
Statistics of Species Abundance Distributions in Monitoring Aquatic Communities,
W83-03035 5C

SPECTRAL ANALYSIS
Determination of the Colour of Water and Waste Water (Bestimmung der Farbigkeit Von Wassern),
W83-02819 5A

SPILLWAYS
Fast-Water Streams Deflected by Transverse Walls,
W83-03003 8B

ST. LAWRENCE SEAWAY
Economic and Environmental Issues of the Proposed Extension of the Winter Navigation Season and Improvements on the Great Lakes-St. Lawrence Seaway System,
W83-03072 6G

STABILIZATION PONDS
Solar Heating of Wastewater Stabilization Ponds,
W83-03100 5D

STATISTICAL ANALYSIS
Maximum Contaminant Levels for Toxic Substances in Water: A Statistical Approach,
W83-03145 5A

STATISTICAL METHODS
Statistics of Species Abundance Distributions in Monitoring Aquatic Communities,
W83-03035 5C

STOCHASTIC HYDROLOGY
Contemporary Stochastic Approach to Water Resource Systems: The ARMP and Feature Prediction Models,
W83-03060 2A

STOCHASTIC PROCESS
Soil Hydraulic Properties as Stochastic Processes: II. Errors of Estimates in a Heterogeneous Field,
W83-02999 2G

STORAGE COEFFICIENT
Aquifer Test Results, Green Swamp Area, Florida,
W83-02980 2F

STORAGE RESERVOIRS
Water and Air Renewal in Reservoirs (Les Reservoirs D'eau Potable. 1-Le Renouvellement Methodique de L'eau et de L'air Dans les Reservoirs),
W83-02815 5G

STORM RUNOFF
Hydrological and Environmental Controls on Water Management in Semiarid Urban Areas -- Phase II,
W83-02918 4D

Organic Carbon and Oxygen Demand Relationships in Stormflow From Southern Pine Watersheds,
W83-03015 5B

STORM WATER
On Subsurface Stormflow: Predictions with Simple Kinematic Theory for Saturated and Unsaturated Flows,
W83-02931 2G

A Modeling Approach for Storm Water Quantity and Quality Control Via Detention Basins,
W83-03147 5G

STRATIFICATION
Physical and Chemical Properties of Pond Waters Receiving Warm-Water Effluent from a Thermal Power Plant,
W83-02954 5C

STRATIFIED FLOW
Turbulent Vertical Momentum Transfer in Stratified Environments,
W83-02901 2E

STRATIGRAPHY
Stratigraphy and Water Table Relationships of Upland Loess-Derived Soils in South-Central Iowa,
W83-02998 2G

STREAM BANKS
Erosion of Banks Along Piedmont Urban Streams,
W83-02945 2J

STREAM DISCHARGE
Development of a Generalized Hydrologic Modelling System,
W83-02946 2E

Streamflow Losses to Madison Group Rocks in the Little Belt and Big Snowy Mountains, Montana,
W83-02974 2E

Effects of a Floodwater-Retarding Structure on the Hydrology and Ecology of Trout Creek in Southwestern Wisconsin.
W83-02985 6G

STREAM EROSION
Erosion of Banks Along Piedmont Urban Streams,
W83-02945 2J

STREAMFLOW
Streamflow Characteristics Related to Channel Geometry of Streams in Western United States,
W83-02969 2E

Flow Model of the Hudson River Estuary From Albany to New Hamburg, New York,
W83-02986 2L

STREAMFLOW DEPLETION
Streamflow Losses to Madison Group Rocks in the Little Belt and Big Snowy Mountains, Montana,
W83-02974 2E

STREAMFLOW FORECASTING
Flow Duration Curves in Tropical Equatorial Regions,
W83-03018 2E

STREAMS
An Ecological Study of Ozark Streams,
W83-02916 6G

Streamflow Characteristics Related to Channel Geometry of Streams in Western United States,
W83-02969 2E

Some Chemical Characteristics of Mine Drainage in Illinois,
W83-02971 5B

Techniques for Estimating Flood Discharges for Unregulated Streams in New Mexico,
W83-02981 2E

STREPTOCOCCUS
The Enumeration of Streptococci and Mycobacteria Present in Landfill Leachate,
W83-02885 5B

STRIP MINES
Hydrologic Characteristics of Surface-Mined Land Reclaimed by Sludge Irrigation, Fulton County, Illinois,
W83-02975 5A

SUBSURFACE FLOW
On Subsurface Stormflow: Predictions with Simple Kinematic Theory for Saturated and Unsaturated Flows,
W83-02931 2G

SUBSURFACE MOISTURE
Midseason Soil Water Recharge for Corn in the Northwestern Corn Belt,
W83-02890 2G

SULFATE
Nature and Extent of Acid Snowpacks in Pennsylvania,
W83-02943 2C

SULFUR DYNAMICS
Effect of Atmospheric Sulfur Pollutants Derived from Acid Precipitation on the Benthic Dynamics of Lakes,
W83-03093 5C

SUNFLOWER
A Water Use Comparison Between Corn and Sunflower,
W83-02828 2I

SURFACE-GROUNDWATER RELATIONS
Preliminary Projections of the Effects of Chloride-Control Structures on the Quaternary Aquifer at Great Salt Plains, Oklahoma,
W83-02988 5G

Hydrology of the Surficial Aquifer in the Floyd River Basin, Iowa,
W83-02993 2F

SURFACE IRRIGATION
Irrigation Water Management for Wide-Spaced Furrow Irrigation,
W83-03037 3F

SURFACE RUNOFF
Hydrologic Data of the Lake Cochituate Drainage Basin, Framingham-Natick, Massachusetts,
W83-02989 7C

Hygienic Evaluation of Water Polluted by Pesticides Entering Water Bodies in Surface Runoff (Gigienicheskaya Otsenka Vody, Zagryaznennoi Nekotorymi Pestitsidami Pri Postuplenii Ikh V Vodoem S Poverkhnostnym Stokom),
W83-03017 5C

SURFACE SEALING
Overland Flow From Sloping Land: Effects of Perched Water Tables and Subsurface Drains,
W83-03028 4A

SURFACE WATER
Design of Surface-Water Data Networks for Regional Information,
W83-02970 7A

SURVEYS
Problems, Issues, Constraints, and Barriers to Water Quality Planning and Management in Urban and Urbanizing Areas (SMSA's) in Tennessee,
W83-02899 6B

SUSPENDED SOLIDS
Contents of Metals and Suspended Solids in the Rhine (Metallgehalt und Schwebstoffgehalt im Rhein),
W83-02813 5B

SWEDEN
Modified Stripping Technique for the Analysis of Trace Organics in Water,
W83-03131 5A

SWITZERLAND
Precaution Measures Against Uplift and Seepage Effects on Gigerwald Arch-Dam (Mesures De Protection Contre Les Effects De La Sous-Pression et Des Infiltrations Au Barrage-Voute De Gigerwald),
W83-02960 8E

Dam and River Sand-Drifting Inspection (La Bathymetrie--Technique De Surveillance De L'Ensablement Des Fleuves Et Des Retenues),
W83-02961 2J

Losses of Water and Underpressures at the Dixence Dam (Pertes D'Eau Et Sous-Pressions Au Barrage De La Grande Dixence),
W83-02962 8F

TANNERY WASTES
A System Developed for the Treatment of Tanning and Other Proteinaceous Effluents,
W83-02853 5D

TECHNOLOGY TRANSFER
Packaging of Information- Part and Parcel of Successful Technology Transfer,
W83-02859 7C

The Role of Consultants,
W83-02860 5D

Theme 4: Technology Transfer: Report of the Session Convenor,
W83-02872 5D

TEMPERATURE EFFECTS
Temperature Dependence of Unsaturated Hydraulic Conductivity of Two Soils,
W83-03000 2G

TENNESSEE
Team Effort Solves Operational Problems,
W83-02805 5D

Problems, Issues, Constraints, and Barriers to Water Quality Planning and Management in Urban and Urbanizing Areas (SMSA's) in Tennessee,
W83-02899 6B

TERTIARY LIMESTONE AQUIFER
Updip Delineation of the Tertiary Limestone Aquifer, South Carolina,
W83-02896 2F

TEST FACILITIES
Sediment Transport in Alluvial Channels: Rates for Erosion and Deposition of Cohesive Sediments Literature Review and Experimental Design,
W83-03032 2J

TEXT WELLS
Hydrologic Data of the Lower Merrimack River Basin, Massachusetts, from Concord River, Lowell, to Plum Island, Newburyport,
W83-02994 7C

TEXTILES
The Performance of an Ultrafiltration Pilot-Plant for the Closed Loop Recycling of Textile Desizing Effluents,
W83-03123 5D

THERMAL POLLUTION
Physical and Chemical Properties of Pond Waters Receiving Warm-Water Effluent from a Thermal Power Plant,
W83-02954 5C

Ultrasonic Telemetry Studies of Fish Activity Near the Nanticoke Thermal Generating Station,
W83-03074 5C

THERMAL SPRINGS
Geothermal Resources in the Banbury Hot Springs Area, Twin Falls County, Idaho,
W83-02972 2F

THIOBACILLUS FERROOXIDANS
Metabolic Properties of Thiobacillus ferrooxidans Isolated from Neutral pH Mine Drainage,
W83-03045 5B

TIDAL EFFECTS
Collocation Formulations for the Finite Element Analysis of Tidal and Transport Processes in Estuaries,
W83-03055 2L

TIDAL FLOWS
Coupling of One- and Two-Dimensional Finite Elements for the Computation of Tidal Flow in Estuaries,
W83-03051 2L

TIME SERIES ANALYSIS
Water Conservation Kits: A Time Series Analysis of a Conservation Policy,
W83-03136 3D

TOXICITY
Response of Methane Fermentation Systems to Industrial Toxicants,
W83-02833 5D

Toxicity Assessment of Snowmelt Water Runoff in an Urban Area (Toxicite Des Eaux De Ruissellement De La Fonte De Neige En Milieu Urbain),
W83-02958 5C

Toxicological Problems Associated with Alternative Methods of Disinfection,
W83-03087 5C

Evaluation of EPA Un-Ionized Ammonia Toxicity Criteria,
W83-03091 5G

TRACE ELEMENTS
Statewide Evaluation of Trace Element Accumulation From Long Term Disposal of Waste Water,
W83-02892 3C

TRACE LEVELS
Modified Stripping Technique for the Analysis of Trace Organics in Water,
W83-03131 5A

TRACE METALS
Statewide Evaluation of Trace Element Accumulation From Long Term Disposal of Waste Water,
W83-02892 3C

Trace Metal Complexation by Fulvic Acid Extracted from Sewage Sludge: II. Development of Chemical Models,
W83-03030 5B

TRAINING
Building Water and Sanitation Projects in Rural Guatemala,
W83-03071 5F

TRANSMISSIVITY
Preliminary Studies of the Reservoir Capacity and the Generating Potential of the Baca Geothermal Field, New Mexico,
W83-02935 2F

Aquifer Test Results, Green Swamp Area, Florida,
W83-02980 2F

TRANSPORT
Collocation Formulations for the Finite Element Analysis of Tidal and Transport Processes in Estuaries,
W83-03055 2L

TRICKLE IRRIGATION
Salinity and Boron Control Under High-Frequency Low-Volume Irrigation,
W83-02908 5B

TRIHALOMETHANES
Seasonal Patterns and Molecular Weight Variations of Trihalomethane Precursors and Trihalomethane Forming Potential in the Kaw Reservoir,
W83-03108 5B

TROPICAL REGIONS
Flow Duration Curves in Tropical Equatorial Regions,
W83-03018 2E

TURBIDITY
Colour and Turbidity Removal With Reusable Magnetite Particles--IV. Alkali Activated Magnetite--A New Solid, Reusable Coagulant-Adsorbent,
W83-02948 5F

Turbidity in the Western Basin of Lake Erie,
W83-03118 2J

TURBINES
Development Potential for Low-Head Hydro,
W83-03005 8C

Small Pump-Turbines to Supplement Grid Capacity,
W83-03006 8C

Installed and Planned Mini Hydro,
W83-03007 8C

Energy for Rural Development,
W83-03008 8C

TURBULENT FLOW
Turbulent Vertical Momentum Transfer in Stratified Environments,
W83-02901 2E

U.S. GEOLOGICAL SURVEY
Water-Data Program of the U.S. Geological Survey,
W83-02967 7A

ULTRAVIOLET ABSORPTION
The Role of DOC, UV Absorption and TOH Measurements in Water Pollution Control,
W83-02882 5D

UNDERGROUND STRUCTURES
The Future of Underground Pumped Hydro.
W83-03012 8A

UNITED KINGDOM
On Subsurface Stormflow: Predictions with Simple Kinematic Theory for Saturated and Unsaturated Flows,
W83-02931 2G

Changes Proposed for Water Management in the United Kingdom,
W83-03065 6E

UNSATURATED FLOW
Improving Design of a Domestic Waste Disposal System Using an Unsaturated Flow Model and Phosphorus Adsorption,
W83-02900 5D

UNSATURATED ZONE PROPAGATION
Hydrocarbon Spills, Their Retention in the Subsurface and Propagation into Shallow Aquifers,
W83-02895 5B

UNSTEADY FLOW
Flow Model of the Hudson River Estuary From Albany to New Hamburg, New York,
W83-02986 2L

UPLIFT PRESSURE
Precaution Measures Against Uplift and Seepage Effects on Gigerwald Arch-Dam (Mesures De Protection Contre Les Effects De La Sous-Pression et Des Infiltrations Au Barrage-Voute De Gigerwald),
W83-02960 8E

URBAN AREAS
Toxicity Assessment of Snowmelt Water Runoff in an Urban Area (Toxicite Des Eaux De Ruissellement De La Fonte De Neige En Milieu Urbain),
W83-02958 5C

URBAN HYDROLOGY
A Modeling Approach for Storm Water Quantity and Quality Control Via Detention Basins,
W83-03147 5G

URBAN PLANNING
Problems, Issues, Constraints, and Barriers to Water Quality Planning and Management in Urban and Urbanizing Areas (SMSA's) in Tennessee,
W83-02899 6B

URBANIZATION
Hydrological and Environmental Controls on Water Management in Semiarid Urban Areas -- Phase II,
W83-02918 4D

Changes in Marsh Area Along the Canadian Shore of Lake Ontario,
W83-03076 4C

URUGUAY
Uruguay's Save Our Soils Campaign.
W83-03134 4D

USSR
Sanitary Microbiologic Assessment of Water Desalination by Distillation (Sanitarno-Mikrobiologicheskaya Otsenka Distillyatsionnogo Metoda Opresneniya Vody),
W83-03010 3A

Hygienic Evaluation of Water Polluted by Pesticides Entering Water Bodies in Surface Runoff (Gigienicheskaya Otsenka Vody, Zagryaznennoi

Nekotorymi Pestitsidami Pri Postuplenii Ikh V Vodoem S Poverkhnostnym Stokom),
W83-03017 5C

UTAH
Runoff and Water Quality From Three Soil Landform Units on Mancos Shale,
W83-03150 2J

VEGETATION
Sedimentation and its Control in Nadis in the Indian Arid Zone - a Case Study,
W83-03133 2J

VIRGIN ISLANDS
Microbial Quality of Water in Old Wells and the Public Water Distribution System in the U. S. Virgin Islands,
W83-03098 5F

Microbial Analysis of Domestic Cistern Water in the U. S. Virgin Islands,
W83-03099 5F

VIRUSES
The Health Significance of Viruses in Water.
W83-02959 5F

Comparative Inactivation of Six Enteroviruses by Ozone,
W83-03068 5F

VOLTAMMETRY
Identification of Total and Biologically Sensitive Forms of Toxic Metal Inputs to an Urban Affected River,
W83-03105 5A

WALES
Transport of Heavy Metals on Suspended Sediments Under High Flow Conditions in a Mineralized Region of Wales,
W83-03048 5B

WASHINGTON
Effects of Farming Practices on Sediment in Irrigation Return Flow,
W83-03039 4D

Identification of Total and Biologically Sensitive Forms of Toxic Metal Inputs to an Urban Affected River,
W83-03105 5A

WASTEWATER
Statewide Evaluation of Trace Element Accumulation From Long Term Disposal of Waste Water,
W83-02892 3C

WASTEWATER ANALYSIS
The Measurement of Total Phosphorus in Waste Water (Le Dosage du Phosphore Total Dans Les Eaux Usees),
W83-02816 5A

WASTEWATER DISPOSAL
Statewide Evaluation of Trace Element Accumulation From Long Term Disposal of Waste Water,
W83-02892 3C

Water Quality Improvement in the Firth or Forth: A Discriminant Functional Analysis,
W83-03059 5G

Solar Heating of Wastewater Stabilization Ponds,
W83-03100 5D

Wastewater Injection Well Problems, Processes and Standards,
W83-03102 5E

Leaching Characteristics of Industrial Metal Finishing Wastewater Treatment Plant Solids,
W83-03122 5E

WASTEWATER IRRIGATION
Microbiological Aerosols From a Field-Source Wastewater Irrigation System,
W83-02835 5B

WASTEWATER OUTFALL
A Chemical Investigation of a Marine Sewage Outfall,
W83-02888 5B

WASTEWATER POLLUTION
Guidelines for the Reduction of Wastewater Tax (Hinweise zur Reduzierung Der Abwasserabgabe),
W83-02801 6F

WASTEWATER TREATMENT
Kinetics of Dissimilatory Nitrate and Nitrite Reduction in Suspended Growth Culture,
W83-02806 5D

Mechanism of Clarification Failure,
W83-02807 5D

Investigations on the Elimination Efficiency of Metal Hydroxide Flocs Which are Made Hydrophobic by Precipitation in the Presence of Sodium Stearate (Untersuchungen Uber Die Eliminationswirkung Hydrophobierter Metalloxidhydrat-Flocken),
W83-02812 5D

Response of Methane Fermentation Systems to Industrial Toxicants,
W83-02833 5D

Flotation as the Final Clarification Step in Waste-Water Treatment and its Influence on the Oxygen Balance of Receiving Waters,
W83-02848 5D

The Application of Pretreatment Procedures to Limit Membrane Fouling in Reverse Osmosis Reclamation of Secondary Sewage Effluents,
W83-02849 5D

Computer Control in a Biological Sewage Plant, Methods and Experience,
W83-02851 5D

Water and Wastewater Treatment With Reusable Magnetite Particles,
W83-02852 5D

A System Developed for the Treatment of Tanning and Other Proteinaceous Effluents,
W83-02853 5D

Research Into the Mass Culture of Algae in Closed Systems,
W83-02854 5D

Physical-Chemical Methods of Treatment for Oil-Containing Effluents,
W83-02855 5D

Low-Cost Technology for Water Pollution Control in Developing Countries,
W83-02858 5D

Scale-Up Problems,
W83-02861 5D

Water Pollution Control in Developing Areas - Training and Education,
W83-02875 5G

Water Pollution Control in Developing Areas: Problems and Needs,
W83-02876 5G

Water Recycling Systems,
W83-02878 3D

Suppression of Density Waves in Clarifiers,
W83-02880 8B

Wastewater Stabilization Lagoon Effluent Upgrading With Modified Intermittent Sand Filters,
W83-02902 5D

Coagulation and Removal of Algal Suspensions From Wastewater Stabilization Ponds,
W83-02903 5D

Automation Study of Activated Sludge Processes,
W83-02909 5D

Laboratory Study of Dynamic-State Control of Activated Sludge Processes,
W83-02910 5D

Volatilization of Organic Trace Contaminants by Air Stripping for Water Reclamation,
W83-02917 5D

A Theoretical and Experimental Investigation of the Dynamics of Breakpoint Chlorination in Dispersed Flow Reactors,
W83-02926 5F

Nitrification Process in a Packed Bed Reactor With a Chemically Active Bed,
W83-02947 5D

Rate Constants of Reactions of Ozone with Organic and Inorganic Compounds in Water--I. Non-Dissociating Organic Compounds,
W83-02950 5F

Rate Constants of Reactions of Ozone With Organic and Inorganic Compounds in Water--II. Dissociating Organic Compounds,
W83-02951 5F

A Kinetic Model of Steady State Phosphorus Fixation in a Batch Reactor--IV,
W83-02952 5D

Theoretical and Experimental Study of Factors Affecting Capillary Suction Time (CST),
W83-02955 5D

EDTA as a Kinetic Inhibitor of Copper(II) Sulfide Precipitation,
W83-02956 5B

Effect of Ozonation on the Biodegradability and Adsorbability of Specific Organics to be Removed in the 'Biologically Activated Carbon (BAC)' Process,
W83-03107 5D

The Effect of Aeration Basin Configuration on Activated Sludge Bulking at Low Organic Loading,
W83-03120 5D

Aerobic Thermophilic Stabilization of Sludge Versus Anaerobic Digestion and Other Kinds of Sludge Treatment at Middle-Sized Plants with Respect to Power Conservation and Economy,
W83-03121 5D

The Performance of an Ultrafiltration Pilot-Plant for the Closed Loop Recycling of Textile Desizing Effluents,
W83-03123 5D

An Integrated Low Cost System for Treatment of Potato Processing Wasterwater Incorporating Anaerobic Fermentation and Phosphorus Removal,
W83-03124 5D

Simultaneous Pasteurization - Digestion (SPD-Process),
W83-03125 5D

Inhibition Modeling In Anaerobic Digestion,
W83-03126 5D

Elements of the Inhibition of Nitrifying Bacteria,
W83-03127 5D

Granular Activated Carbon and Preozonated Granular Activated Carbon Treatment for Biologically and Physically-Chemically Treated Wastewater Effluents,
W83-03128 5D

An in Situ Comparison of the Effectiveness of Four Algicides,
W83-03137 5D

WASTEWATER TREATMENT FACILITIES
The Successes of Increased Wastewater Treatment Plant Construction on the Rhine (Erfolge Verstarkten Klaranlagenbaus Am Rhein),
W83-02802 5G

WASTWATER TREATMENT
Solar Heating of Wastewater Stabilization Ponds,
W83-03100 5D

WATER ALLOCATION
Laws and Institutions That Regulate Surface Waters in Mexico (Commentarios a Las Leyes e Instituciones Que Reglamentan Las Aguas Superficiales de Mexico),
W83-03004 6E

The Quality of Water of the Rio Bravo Basin (La Calidad De Las Aguas Del Bajo Rio Bravo),
W83-03019 6E

Surface Water Availability and Future Demand along the Border from Juarez to Matamoros (Disponibilidad de Aguas Superficiales Y su Demanda Futuro a lo Largo De la Franja Fronteriza Desde Ciudad Juarez, Chihuahua, Hasta Matamoros, Tamaulipas),
W83-03022 6E

The Impact of Energy Development in the Tongue River Basin, Southeastern Montana,
W83-03139 4C

The Potential Impact of Water Reallocations on Agriculture in Idaho,
W83-03143 6B

WATER ANALYSIS
A Simplified Scheme for the Analysis of Pollutants in Groundwater and Leachates Contaminated by Hazardous Chemicals,
W83-02904 5A

Geothermal Resources in the Banbury Hot Springs Area, Twin Falls County, Idaho,
W83-02972 2F

Soluble Reactive Phosphorus Measurements in Lake Michigan: Filtration Artifacts,
W83-03084 5A

WATER CIRCULATION
On Lagrangian Residual Currents With Applications in South San Francisco Bay, California,
W83-02928 2L

WATER CONSERVATION
Water Policy: A California Split,
W83-02838 3F

Irrigation Water Management for Wide-Spaced Furrow Irrigation,
W83-03037 3F

WATER CONSUMPTION
Water Conservation Kits: A Time Series Analysis of a Conservation Policy,
W83-03136 3D

WATER CONVEYANCE
River and Watercourse Crossings and Lake Outlets With HDPE Pipes (Fluss- und Gewasserkreuzungen Sowie Seeauslaufleitungen Mit Rohren Aus HDPE),
W83-02803 8G

Modern Information Systems for Water Supply Companies-Requirements and Functions (Moderne Informationssysteme Fur Wasserwarten - Anforderungen Und Funktionen),
W83-03058 7A

WATER CURRENTS
On Lagrangian Residual Currents With Applications in South San Francisco Bay, California,
W83-02928 2L

Stream Function Finite Elements for Nearshore Current,
W83-03064 2L

WATER DEMAND
Water Recycling: Review and Background,
W83-02877 3E

Water Recycling - Industrial Applications,
W83-02879 3E

Price, Socioeconomic, and Climatic Influences on Residential Water Use in Southern Arizona,
W83-02894 6D

Estimated Water Use in Florida, 1980,
W83-02990 6D

WATER DISTRIBUTION
Sanitary Problems in Relationship With Tap Water Distributed in New or Recent Buildings of Paris (Problems Sanitaires Poses A Paris Par L'Eau Potable Dans Les Immeubles Neufs Ou Recents),
W83-02844 5F

Optimal Annual Operation of a Water Supply and Distribution System,
W83-03062 6A

Obtaining an Analytical Grasp of Water Distribution Systems,
W83-03066 5F

WATER EXCHANGE
The Influence of Water Exchange On Water Quality and Fish Production in Channel Catfish Ponds,
W83-02905 5G

WATER HARVESTING
Optimal Design of Small Reservoir Systems,
W83-02836 3B

Microbial Quality of Water in Old Wells and the Public Water Distribution System in the U. S. Virgin Islands,
W83-03098 5F

Microbial Analysis of Domestic Cistern Water in the U. S. Virgin Islands,
W83-03099 5F

WATER LAW
Guidelines for the Reduction of Wastewater Tax (Hinweise zur Reduzierung Der Abwasserabgabe),
W83-02801 6F

Federal Water Policy and New Mexico Water,
W83-02922 6E

The Legislative Reality of a National Water Policy,
W83-02923 6E

Laws and Institutions That Regulate Surface Waters in Mexico (Commentarios a Las Leyes e Instituciones Que Reglamentan Las Aguas Superficiales de Mexico),
W83-03004 6E

WATER LEVEL STABILIZATION
Biological and Recreational Aspects of Water Level Management for Clear Lake, Iowa,
W83-03036 6G

WATER LOSS
Losses of Water and Underpressures at the Dixence Dam (Pertes D'Eau Et Sous-Pressions Au Barrage De La Grande Dixence),
W83-02962 8F

WATER MANAGEMENT
The Use of Water Quality Models in Management Decision Making,
W83-02847 5G

Application to Rivers and Underground Waters,
W83-02866 5G

Funding Water Pollution Control in South Africa,
W83-02870 6F

Theme 5: Water Pollution Control in Developing Countries: Report of the Session Convenor,
W83-02873 6F

Evapotranspiration of Applied Water, Central Valley, California, 1957-78,
W83-02984 2D

Irrigation Water Management for Wide-Spaced Furrow Irrigation,
W83-03037 3F

Changes Proposed for Water Management in the United Kingdom,
W83-03065 6E

WATER POLICY
Water Policy: A California Split,
W83-02838 3F

Federal Water Policy and New Mexico Water,
W83-02922 6E

The Legislative Reality of a National Water Policy,
W83-02923 6E

WATER POLLUTION
Some Chemical Characteristics of Mine Drainage in Illinois,
W83-02971 5B

WATER POLLUTION CONTROL
The Successes of Increased Wastewater Treatment Plant Construction on the Rhine (Erfolge Verstarkten Klaranlagenbaus Am Rhein),
W83-02802 5G

History of Accidental Pollutions Which Have Occurred in the World (Historique des Pollutions Accidentelles Survenues Dans Le Monde),
W83-02817 5B

Clean Water Act - The View From Here,
W83-02832 6E

Low-Cost Technology for Water Pollution Control in Developing Countries,
W83-02858 5D

Balancing Benefits and Expenditure in Water Pollution Control,
W83-02862 6B

The Use of Mathematical Models in the Formulation of Pollution Control Policies - An Overview,
W83-02864 5

Application to Estuarine and Coastal Waters,
W83-02865 5B

Legal and Administrative Control Aspects of Oil Pollution,
W83-02868 5G

Theme 3: The Economics of Water Pollution Control and Research: Introduction by the Session Convenor,
W83-02869 6B

Funding Water Pollution Control in South Africa,
W83-02870 6F

Funding Water Pollution Research,
W83-02871 9C

Theme 5: Water Pollution Control in Developing Countries: Report of the Session Convenor,
W83-02873 6F

Water Pollution Control in Developing Areas - Training and Education,
W83-02875 5G

Water Pollution Control in Developing Areas: Problems and Needs,
W83-02876 5G

The Role of DOC, UV Absorption and TOH Measurements in Water Pollution Control,
W83-02882 5D

The National Recreational Fishing Benefits of Water Pollution Control,
W83-03130 6B

Benefits of Pollution Control on Massachusetts' Housatonic River: A Hedonic Pricing Approach,
W83-03141 6B

WATER POLLUTION EFFECTS

The Impact of Diffuse Atmospheric Nutrient Loading on an Oligotrophic Freshwater Lake in a Developing Urban and Industrial Area (Richards Bay, South Africa),
W83-02850 5C

A Chemical Investigation of a Marine Sewage Outfall,
W83-02888 5B

Toxicity Assessment of Snowmelt Water Runoff in an Urban Area (Toxicite Des Eaux De Ruissellement De La Fonte De Neige En Milieu Urbain),
W83-02958 5C

Delineation and Hydrologic Effects of a Gasoline Leak at Stovepipe Wells Hotel, Death Valley National Monument, California,
W83-02982 5B

WATER POLLUTION PREVENTION

The Successes of Increased Wastewater Treatment Plant Construction on the Rhine (Erfolge Verstarkten Klaranlagenbaus Am Rhein),
W83-02802 5G

History of Accidental Pollutions Which Have Occurred in the World (Historique des Pollutions Accidentelles Survenues Dans Le Monde),
W83-02817 5B

Pollution Potential Ranking of Barnyards for Priority Watershed Planning,
W83-02915 5G

WATER POLLUTION SOURCES

History of Accidental Pollutions Which Have Occurred in the World (Historique des Pollutions Accidentelles Survenues Dans Le Monde),
W83-02817 5B

Sources of Petroleum Hydrocarbon Inputs to the Marine Environment,
W83-02863 5B

Mineralization Problems in the PWV Complex - The Identification of Viable Solutions by Means of a Suite of Mathematical Models,
W83-02881 5G

The Enumeration of Streptococci and Mycobacteria Present in Landfill Leachate,
W83-02885 5B

Hygienic Evaluation of Water Polluted by Pesticides Entering Water Bodies in Surface Runoff (Gigienicheskaya Otsenka Vody, Zagryaznennoi Nekotorymi Pestitsidami Pri Postuplenii Ikh V Vodoem S Poverkhnostnym Stokom),
W83-03017 5C

WATER PRESSURE

Losses of Water and Underpressures at the Dixence Dam (Pertes D'Eau Et Sous-Pressions Au Barrage De La Grande Dixence),
W83-02962 8F

WATER PRICING

Price, Socioeconomic, and Climatic Influences on Residential Water Use in Southern Arizona,
W83-02894 6D

WATER QUALITY

Trends in Lake Ontario Surveillance Parameters, 1974-1980,
W83-02840 2H

Mineralization Problems in the PWV Complex - The Identification of Viable Solutions by Means of a Suite of Mathematical Models,
W83-02881 5G

Some Chemical Characteristics of Mine Drainage in Illinois,
W83-02971 5B

Hydrologic Characteristics of Surface-Mined Land Reclaimed by Sludge Irrigation, Fulton County, Illinois,
W83-02975 5A

Aquatic Biology in Nederlo Creek, Southwestern Wisconsin,
W83-02978 6G

Preliminary Projections of the Effects of Chloride-Control Structures on the Quaternary Aquifer at Great Salt Plains, Oklahoma,
W83-02988 5G

Hydrology of the Surficial Aquifer in the Floyd River Basin, Iowa,
W83-02993 2F

The Quality of Water of the Rio Bravo Basin (La Calidad De Las Aguas Del Bajo Rio Bravo),
W83-03019 6E

An Environmental Quality Index for the Great Lakes,
W83-03148 7C

WATER QUALITY CONTROL

Water and Air Renewal in Reservoirs (Les Reservoirs D'eau Potable. 1-Le Renouvellement Methodique de L'eau et de L'air Dans les Reservoirs),
W83-02815 5G

The Use of Water Quality Models in Management Decision Making,
W83-02847 5G

Application to Rivers and Underground Waters,
W83-02866 5G

Utilization of Computerized Water Monitoring and Information System,
W83-02883 7A

Effects of Water Exchange on Water Quality in Channel Catfish Ponds,
W83-02897 5G

The Influence of Water Exchange On Water Quality and Fish Production in Channel Catfish Ponds,
W83-02905 5G

WATER QUALITY STANDARDS

Evaluation of EPA Un-Ionized Ammonia Toxicity Criteria,
W83-03091 5G

Maximum Contaminant Levels for Toxic Substances in Water: A Statistical Approach,
W83-03145 5A

WATER REQUIREMENTS

Water Requirements for Flooded Rice Cultivation,
W83-03002 3F

WATER RESOURCES DEVELOPMENT

Water Resources and Data-Network Assessment of the Manasota Basin, Manatee and Sarasota Counties, Florida,
W83-02973 7A

Contemporary Stochastic Approach to Water Resource Systems: The ARMP and Feature Prediction Models,
W83-03060 2A

WATER REUSE

Production of Algal Protein in Raw Sewage,
W83-02856 3C

Water Recycling: Review and Background,
W83-02877 3E

Water Recycling Systems,
W83-02878 3D

Water Recycling - Industrial Applications,
W83-02879 3E

The Exhaustive Reuse of Water in Food Processing,
W83-02884 3E

WATER RIGHTS

The Legislative Reality of a National Water Policy,
W83-02923 6E

WATER SAMPLING ARTIFACTS

Artifacts and Losses in the Sampling of Chlorinated Waters by XAD Adsorption,
W83-03104 5A

WATER SHORTAGE

Is the Ogallala Going Dry.
W83-02839 3F

WATER STORAGE

Significance on the New Large Water Reservoir Schonbuhl and Its Consequences on the Landeswasserversorgung Stuttgart (Die Bedeutung Des Neuen Grossbehalters Schonbuhl Fur Die Landeswasserversorgung Stuttgart),
W83-02963 8A

WATER STRESS

Evaporative Flux From Wheat and Fallow in a Semiarid Climate,
W83-02965 2D

WATER SUPPLY

Telecontrol and the Computer in Water Supply (Telesurveillance Et Ordinateur Au Service Des Eaux),
W83-02846 5F

Delineation and Hydrologic Effects of a Gasoline Leak at Stovepipe Wells Hotel, Death Valley National Monument, California,
W83-02982 5B

Building Water and Sanitation Projects in Rural Guatemala,
W83-03071 5F

WATER SUPPLY DEVELOPMENT

Supply of a Rural Community in the Rhone Department by Means of Mid-Depth Drilling in the 'Molasse' of the Bas-Dauphine (Alimentation D'Une Commune Rurale Du Department Du Rhone Au Moyen D'Un Forage De Profondeur Moyenne Dans La ('Molasse' Du Bas-Dauphine),
W83-02845 3B

Optimal Annual Operation of a Water Supply and Distribution System,
W83-03062 6A

WATER TABLE
Stratigraphy and Water Table Relationships of Upland Loess-Derived Soils in South-Central Iowa,
W83-02998 2G

WATER TABLE FLUCTATIONS
Overland Flow From Sloping Land: Effects of Perched Water Tables and Subsurface Drains,
W83-03028 4A

WATER TEMPERATURE
Geothermal Resources in the Banbury Hot Springs Area, Twin Falls County, Idaho,
W83-02972 2F

Stream Temperature Under an Inadequate Buffer Strip in the Southeast Piedmont,
W83-03149 6G

WATER TRANSPORT
Transport of Water in Frozen Soil: I. Experimental Determination of Soil-Water Diffusivity Under Isothermal Conditions,
W83-03054 2C

WATER TREATMENT
Volatilization of Organic Trace Contaminants by Air Stripping for Water Reclamation,
W83-02917 5D

Waste From the Water Treatment Plant at Alton and Its Impact on the Mississippi River,
W83-02920 5E

Colour and Turbidity Removal With Reusable Magnetite Particles--IV. Alkali Activated Magnetite--A New Solid, Reusable Coagulant-Adsorbent,
W83-02948 5F

Effect of Solution Chemistry on Coagulation with Hydrolyzed Al(III): Significance of Sulfate Ion and pH,
W83-02949 5F

Rate Constants of Reactions of Ozone With Organic and Inorganic Compounds in Water--II. Dissociating Organic Compounds,
W83-02951 5F

The Health Significance of Viruses in Water.
W83-02959 5F

Sanitary Microbiologic Assessment of Water Desalination by Distillation (Sanitarno-Mikrobiologicheskaya Otsenka Distillyatsionnogo Metoda Opresneniya Vody),
W83-03010 3A

Recent Developments in Water Treatment in France,
W83-03069 5F

New Method Simplifies Sludge Disposal.
W83-03070 5E

Toxicological Problems Associated with Alternative Methods of Disinfection,
W83-03087 5C

The Role of Filtration in Preventing Waterborne Disease,
W83-03088 5F

A Model of Costs for Treating Drinking Water,
W83-03089 5F

WATER TREATMENT FACILITIES
Waste From the Water Treatment Plant at Alton and Its Impact on the Mississippi River,
W83-02920 5E

WATER USE
A Water Use Comparison Between Corn and Sunflower,
W83-02828 2I

Price, Socioeconomic, and Climatic Influences on Residential Water Use in Southern Arizona,
W83-02894 6D

Water Resources and Data-Network Assessment of the Manasota Basin, Manatee and Sarasota Counties, Florida,
W83-02973 7A

Estimated Water Use in Florida, 1980,
W83-02990 6D

Hydrology of the Surficial Aquifer in the Floyd River Basin, Iowa,
W83-02993 2F

Laws and Institutions That Regulate Surface Waters in Mexico (Commentarios a Las Leyes e Instituciones Que Reglamentan Las Aguas Superficiales de Mexico),
W83-03004 6E

WATER YIELD
Ground-Water Resources of the Arcadia-Minden Area, Louisiana,
W83-02991 2F

WATERSHED MANAGEMENT
Pollution Potential Ranking of Barnyards for Priority Watershed Planning,
W83-02915 5G

WATERSHEDS
A Study of the Bed-Load Yield From a Watershed,
W83-03096 2J

WAVES
Wave Action and Bottom Shear Stresses in Lake Erie,
W83-03073 2H

WEATHER
Weather and Consumptive Use in the Bear River Basin, Idaho During 1982,
W83-02911 2D

WELL YIELD
Use of Geologic and Water Yield Data from Ground Water Based Community Water Systems as a Guide for Ground Water Planning and Management,
W83-03046 4B

WELLS
Application of Linear Systems Theory and Linear Programming to Ground Water Management in Kansas,
W83-03142 4B

WESTERN UNITED STATES
Streamflow Characteristics Related to Channel Geometry of Streams in Western United States,
W83-02969 2E

WISCONSIN
Soil Conservation in the Coon Creek Basin, Wisconsin,
W83-02827 4D

Aquatic Biology in Nederlo Creek, Southwestern Wisconsin,
W83-02978 6G

Effects of a Floodwater-Retarding Structure on the Hydrology and Ecology of Trout Creek in Southwestern Wisconsin.
W83-02985 6G

XAD RESINS
Artifacts and Losses in the Sampling of Chlorinated Waters by XAD Adsorption,
W83-03104 5A

ZINC
Sorption and Sedimentation of Zn and Cd by Seston in Southern Lake Michigan,
W83-03083 5B

AUTHOR INDEX

AASE, J. K.
Evaporative Flux From Wheat and Fallow in a Semiarid Climate,
W83-02965 2D

ABE, H.
Opening of a Fault and Resulting Slip Due to Injection of Fluid for the Extraction of Geothermal Heat,
W83-03132 4B

ABOUKHESHEM, M. B.
Computer-Linked CCD Camera for Sediment Shape Analysis,
W83-03111 7B

ADAMS, J. R.
Hydrology, Hydraulics, and Sediment Transport, Kankakee and Iroquois Rivers,
W83-02921 2J

AFAG, S. M.
Application of Numerical Simulation Techniques to Floodplain Management,
W83-02893 2E

AKEHATA, T.
Theoretical and Experimental Study of Factors Affecting Capillary Suction Time (CST),
W83-02955 5D

ALBRECHT, D. R.
Water Recycling - Industrial Applications,
W83-02879 3E

ALERCON, L.
Agricultural Vs. Hydropower Tradeoffs in the Operation of the High Aswan Dam,
W83-02934 6B

ALLEN, H. E.
The Measurement of Complexation Capacity and Conditional Stability Constants for Ligands in Natural Waters,
W83-02957 5A

ALLEN, R. G.
Weather and Consumptive Use in the Bear River Basin, Idaho During 1982,
W83-02911 2D

ALLMARAS, R. R.
Runoff and Soil Erosion on Frozen Soils in Northeastern Oregon,
W83-02826 2J

AMEZAL, A.
History of Accidental Pollutions Which Have Occurred in the World (Historique des Pollutions Accidentelles Survenues Dans Le Monde),
W83-02817 5B

AMOS, D. F.
Water Adsorption and Swelling of Clay Minerals in Soil Systems,
W83-02996 2G

ANDERSON, G. K.
Inhibition Modeling In Anaerobic Digestion,
W83-03126 5D

ANDERSON, N. J.
Water and Wastewater Treatment With Reusable Magnetite Particles,
W83-02852 5D

ARAL, M. M.
Aquifer Parameter Prediction by Numerical Modeling,
W83-02912 2F

ARCHIBALD, C. G. M.
The Impact of Diffuse Atmospheric Nutrient Loading on an Oligotrophic Freshwater Lake in a Developing Urban and Industrial Area (Richards Bay, South Africa),
W83-02850 5C

ARTHUR, J. F.
The Striped Bass Decline in the San Francisco Bay-Delta Estuary,
W83-02919 5C

BADER, H.
Rate Constants of Reactions of Ozone with Organic and Inorganic Compounds in Water--I. Non-Dissociating Organic Compounds,
W83-02950 5F

Rate Constants of Reactions of Ozone With Organic and Inorganic Compounds in Water--II. Dissociating Organic Compounds,
W83-02951 5F

BAETZ, J.
Supply of a Rural Community in the Rhone Department by Means of Mid-Depth Drilling in the 'Molasse' of the Bas-Dauphine (Alimentation D'Une Commune Rurale Du Department Du Rhone Au Moyen D'Un Forage De Profondeur Moyenne Dans La ('Molasse' Du Bas-Dauphine),
W83-02845 3B

BAKER, D. G.
An Experimental Investigation of Evapotranspiration Estimation Methods,
W83-03034 2D

BALTZ, D. M.
Instream Flow Requirements of Native California Stream Fishes,
W83-02906 6G

BARICA, J.
Lake Erie Oxygen Depletion Controversy,
W83-02824 5G

BARNETT, P. W.
Leaching Characteristics of Industrial Metal Finishing Wastewater Treatment Plant Solids,
W83-03122 5E

BARNWELL, T. O. JR
The Use of Water Quality Models in Management Decision Making,
W83-02847 5G

BARRON, T. S.
Design and Evaluation of an AFVC Wash Column With Direct Melting on the Ice Plug,
W83-03040 3A

BARTLETT, P. D.
A Chemical Investigation of a Marine Sewage Outfall,
W83-02888 5B

Nutrient-Salinity Relationships in Four Estuaries of the Cape Province, South Africa,
W83-02889 5B

BARTON, D. A.
Evaluation of EPA Un-Ionized Ammonia Toxicity Criteria,
W83-03091 5G

BARTONE, C. R.
Lake-Wide Seasonal Changes in Limnological Conditions in Lake Michigan in 1976,
W83-03079 2H

BATES, M. H.
The Effects of pH and Redox Potential on the Release of Heavy Metals From Arkansas River Sediments,
W83-03112 5B

BATES, R. E.
Microbiological Aerosols From a Field-Source Wastewater Irrigation System,
W83-02835 5B

BATU, V.
Time-Dependent, Linearized Two-Dimensional Infiltration and Evaporation from Nonuniform and Nonperiodic Strip Sources,
W83-02938 2G

BAUSUM, H. T.
Microbiological Aerosols From a Field-Source Wastewater Irrigation System,
W83-02835 5B

BEAULAC, M. N.
An Examination of Land Use - Nutrient Export Relationships,
W83-03144 5B

BECCARI, M.
Kinetics of Dissimilatory Nitrate and Nitrite Reduction in Suspended Growth Culture,
W83-02806 5D

BENEFIELD, L. D.
Mortality Patterns of Indicator Organisms During Aerobic Digestion,
W83-02834 5E

BENNER, R.
Microbial Degradation of Natural and Pollutionally-Derived Lignocellulosic Detritus in Wetland Ecosystems,
W83-02913 5B

BERNARD, R.
Spatial Variability of Surface Temperature Along Two Transects of a Bare Soil,
W83-02940 2G

BERNE, F.
Physical-Chemical Methods of Treatment for Oil-Containing Effluents,
W83-02855 5D

BEVEN, K.
On Subsurface Stormflow: Predictions with Simple Kinematic Theory for Saturated and Unsaturated Flows,
W83-02931 2G

BHOWMIK, N. G.
Hydrology, Hydraulics, and Sediment Transport, Kankakee and Iroquois Rivers,
W83-02921 2J

BIERMAN, V. J. JR.
Mass Balance Modeling of Heavy Metals in Saginaw Bay, Lake Huron,
W83-02820 5B

BIGELOW, S. M.
Soluble Reactive Phosphorus Measurements in Lake Michigan: Causes of Method-Specific Differences,
W83-02821 5A

Soluble Reactive Phosphorus Measurements in Lake Michigan: Filtration Artifacts,
W83-03084 5A

BIGGAR, J. W.
Salinity and Boron Control Under High-Frequency Low-Volume Irrigation,
W83-02908 5B

Salinity Investigations in West Salt Creek, Colorado,
W83-02925 5B

BILLINGS, R. B.
Price, Socioeconomic, and Climatic Influences on Residential Water Use in Southern Arizona,
W83-02894 6D

BILLS, G.
An in Situ Comparison of the Effectiveness of Four Algicides,
W83-03137 5D

BINGHAM, F. T.
Trace Metal Complexation by Fulvic Acid Extracted from Sewage Sludge: II. Development of Chemical Models,
W83-03030 5B

BIONDI, M.
Atypical Mycobacteria Isolated at Catania (Microbatteri Atipici Isolati a Catania),
W83-03009 5A

BISHOP, J. W.
Updip Delineation of the Tertiary Limestone Aquifer, South Carolina,
W83-02896 2F

BISHOP, R. C.
An Economic Analysis of Integrated Fisheries Management: The Case of the Lake Michigan Alewife and Salmonid Fisheries,
W83-02811 6B

BLACK, T. A.
Test of an Equation for Evaporation From Bare Soil,
W83-02929 2G

BLAKE, G. R.
The Effect of Turfgrass Thatch on Water Infiltration Rates,
W83-03023 4A

Midseason Soil Water Recharge for Corn in the Northwestern Corn Belt,
W83-02890 2G

BODVARSSON, G. S.
Preliminary Studies of the Reservoir Capacity and the Generating Potential of the Baca Geothermal Field, New Mexico,
W83-02935 2F

BOKAIAN, A. R.
Fast-Water Streams Deflected by Transverse Walls,
W83-03003 8B

BOLTO, B. A.
Water and Wastewater Treatment With Reusable Magnetite Particles,
W83-02852 5D

BONELLI, J. E.
Chemical Composition of Bulk Precipitation in the North-Central and Northeastern United States, December 1980 Through February 1981,
W83-02968 2K

BONNEFILLE, M.
The Measurement of Total Phosphorus in Waste Water (Le Dosage du Phosphore Total Dans Les Eaux Usees),
W83-02816 5A

BOREN, H.
Modified Stripping Technique for the Analysis of Trace Organics in Water,
W83-03131 5A

BOST, J. F.
History of Accidental Pollutions Which Have Occurred in the World (Historique des Pollutions Accidentelles Survenues Dans Le Monde),
W83-02817 5B

BOTHA, G. R.
The Application of Pretreatment Procedures to Limit Membrane Fouling in Reverse Osmosis Reclamation of Secondary Sewage Effluents,
W83-02849 5D

BOTSFORD, L. W.
The Striped Bass Decline in the San Francisco Bay-Delta Estuary,
W83-02919 5C

BOUCHER, R.
Behavior of Fishes in the Desaulniers River Basin After Filling of the Desaulniers Reservoir (Comportement Des Poissons Du Bassin De La Riviere Desaulniers Apres Le Remplissage Du Reservoir Desaulniers),
W83-03050 6G

BOUDJOUK, P.
Potential Organometallic Carcinogens in Wastewater Effluents From Coal Gasification Plants,
W83-03110 5B

BOWEN, G. E.
Problems, Issues, Constraints, and Barriers to Water Quality Planning and Management in Urban and Urbanizing Areas (SMSA's) in Tennessee,
W83-02899 6B

BOWMAN, D. D.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W83-02887 5B

BOYD, C. E.
Effects of Water Exchange on Water Quality in Channel Catfish Ponds,
W83-02897 5G

BRADFORD, J. M.
A Numerical Study of Raindrop Impact Phenomena: The Rigid Case,
W83-03029 2J

BRADLEY, S. B.
Transport of Heavy Metals on Suspended Sediments Under High Flow Conditions in a Mineralized Region of Wales,
W83-03048 5B

BRAMLEY, M. E.
Water Requirements for Flooded Rice Cultivation,
W83-03002 3F

BRANSON, F. A.
Methodology for Hydrologic Evaluation of a Potential Surface Mine: Loblolly Branch Basin, Tuscaloosa County, Alabama,
W83-02976 6G

BRESLER, E.
Soil Hydraulic Properties as Stochastic Processes: II. Errors of Estimates in a Heterogeneous Field,
W83-02999 2G

BRIAT, M.
Chemistry of South Polar Snow,
W83-03119 2K

BROCKWAY, C. E.
Weather and Consumptive Use in the Bear River Basin, Idaho During 1982,
W83-02911 2D

BROMSTRUP, H.
River and Watercourse Crossings and Lake Outlets With HDPE Pipes (Fluss- und Gewasserkreuzungen Sowie Seeauslaufleitungen Mit Rohren Aus HDPE),
W83-02803 8G

BROWN, D. P.
Water Resources and Data-Network Assessment of the Manasota Basin, Manatee and Sarasota Counties, Florida,
W83-02973 7A

BROWN, E. J.
Metabolic Properties of Thiobacillus ferrooxidans Isolated from Neutral pH Mine Drainage,
W83-03045 5B

BRUNNER, D.
The Enumeration of Streptococci and Mycobacteria Present in Landfill Leachate,
W83-02885 5B

The Survival of Bacterial Indicators in Lysimeters and Landfills,
W83-02886 5E

BRUTSAERT, W. F.
Improving Design of a Domestic Waste Disposal System Using an Unsaturated Flow Model and Phosphorus Adsorption,
W83-02900 5D

BRYNOFF, L.
Legal and Administrative Aspects,
W83-02874 5G

BUCHANAN, T. J.
Water-Data Program of the U.S. Geological Survey,
W83-02967 7A

BUCKLEY, C. A.
The Performance of an Ultrafiltration Pilot-Plant for the Closed Loop Recycling of Textile Desizing Effluents,
W83-03123 5D

BULL, R.
The Relationship of Minerals Commonly Found in Drinking Water to Atherosclerosis and Hypertension in Pigeons,
W83-03081 5C

BULL, R. J.
Toxicological Problems Associated with Alternative Methods of Disinfection,
W83-03087 5C

BUONO, A.
Delineation and Hydrologic Effects of a Gasoline Leak at Stovepipe Wells Hotel, Death Valley National Monument, California,
W83-02982 5B

BUR, M. T.
Food of Freshwater Drum in Western Lake Erie,
W83-02810 2H

BUSSER, J.
Modern Information Systems for Water Supply Companies-Requirements and Functions (Moderne Informationssysteme Fur Wasserwarten - Anforderungen Und Funktionen),
W83-03058 7A

CANNON, T.
The Striped Bass Decline in the San Francisco Bay-Delta Estuary,
W83-02919 5C

CARSWELL, W. J. JR.
Storage Requirements to Sustain Gross Reservoir Outflow From Small Basins in Kansas,
W83-02992 2E

CARVALHO, L. B.
The Exhaustive Reuse of Water in Food Processing,
W83-02884 3E

CASS, A.
Soil Pore Structural Stability and Irrigation Water Quality: I. Empirical Sodium Stability Model,
W83-03027 2G

Soil Pore Structural Stability and Irrigation Water Quality: II. Sodium Stability Data,
W83-03026 2G

Soil Pore Structural Stability and Irrigation Water Quality: III. Evaluation of Soil Stability and Crop Yield in Relation to Salinity and Sodicity,
W83-03025 2G

CASULLI, V.
On Lagrangian Residual Currents With Applications in South San Francisco Bay, California,
W83-02928 2L

CECH, J. J.
Metabolism of California Stream Fishes,
W83-02944 5C

CHAMBERS, R. L.
Soluble Reactive Phosphorus Measurements in Lake Michigan: Causes of Method-Specific Differences,
W83-02821 5A

CHAPRA, S. C.
Effectiveness of Treatment to Meet Phosphorus Objectives in the Great Lakes,
W83-02830 5G

CHEH, A. M.
Artifacts and Losses in the Sampling of Chlorinated Waters by XAD Adsorption,
W83-03104 5A

CHENG, R. T.
On Lagrangian Residual Currents With Applications in South San Francisco Bay, California,
W83-02928 2L

CHERKINSKY, S. N.
Pollution of Ground Waters by Chlorocholine Chloride Used in Agriculture (Voprosy Zagryazneniya Gruntovykh Vod Pri Primenenii Khlorkholinkhlorida V Selyskom Khozyaistve),
W83-03011 5B

CHIAN, E. S. K.
Comparative Inactivation of Six Enteroviruses by Ozone,
W83-03068 5F

CHU, R. L.
A Kinetic Model of Steady State Phosphorus Fixation in a Batch Reactor--IV,
W83-02952 5D

CILLIE, G. G.
Low-Cost Technology for Water Pollution Control in Developing Countries,
W83-02858 5D

CLARK, B. J.
The Exhaustive Reuse of Water in Food Processing,
W83-02884 3E

CLARK, R. M.
A Model of Costs for Treating Drinking Water,
W83-03089 5F

CLARK, W. M.
Water Requirements for Flooded Rice Cultivation,
W83-03002 3F

CLOTHIER, B. E.
Water Diffusivity of a Field Soil,
W83-02995 2G

CLOUET D'ORVAL, M.
Supply of a Rural Community in the Rhone Department by Means of Mid-Depth Drilling in the 'Molasse' of the Bas-Dauphine (Alimentation D'Une Commune Rurale Du Department Du Rhone Au Moyen D'Un Forage De Profondeur Moyenne Dans La ('Molasse' Du Bas-Dauphine),
W83-02845 3B

COKER, E. L.
Characterization and Treatability of the By-Products of Chlorination of Naturally Occurring Humic Substances,
W83-03106 5F

COLEMAN, T. L.
Stratigraphy and Water Table Relationships of Upland Loess-Derived Soils in South-Central Iowa,
W83-02998 2G

COLLINS, J. R.
Team Effort Solves Operational Problems,
W83-02805 5D

COLQUHOUN, D. J.
Updip Delineation of the Tertiary Limestone Aquifer, South Carolina,
W83-02896 2F

CONSTANTZ, J.
Temperature Dependence of Unsaturated Hydraulic Conductivity of Two Soils,
W83-03000 2G

COOK, K.
Water Policy: A California Split,
W83-02838 3F

COUILLARD, D.
Toxicity Assessment of Snowmelt Water Runoff in an Urban Area (Toxicite Des Eaux De Ruissellement De La Fonte De Neige En Milieu Urbain),
W83-02958 5C

COX, G. C.
The Striped Bass Decline in the San Francisco Bay-Delta Estuary,
W83-02919 5C

COX, S. B.
Building Water and Sanitation Projects in Rural Guatemala,
W83-03071 5F

CULLER, R. C.
Evapotranspiration Before and After Clearing Phreatophytes, Gila River Flood Plain, Graham County, Arizona,
W83-02966 2D

CUSHMAN, J. H.
A Numerical Study of Raindrop Impact Phenomena: The Rigid Case,
W83-03029 2J

Proofs of the Volume Averaging Theorems for Multiphase Flow,
W83-03063 8B

D'ANDREA, R. A.
Safety Factors for Probabilistic Slope Design,
W83-03090 8D

DAIGGER, G. T.
Team Effort Solves Operational Problems,
W83-02805 5D

DANIEL, T. C.
Pollution Potential Ranking of Barnyards for Priority Watershed Planning,
W83-02915 5G

DAVIDSON-ARNOTT, R. G. D.
Shore Protection in the Town of Stoney Creek, Southwest Lake Ontario, 1934-1979: Historical Changes and Durability of Structures,
W83-02842 4D

DAY, W. M.
Price, Socioeconomic, and Climatic Influences on Residential Water Use in Southern Arizona,
W83-02894 6D

DE MONSABERT, S. M.
Management of Existing Reservoir Systems by Interactive Optimization,
W83-02924 6A

DE SMEDT, F.
Application to Rivers and Underground Waters,
W83-02866 5G

DE VILLIERS, H. A.
The Application of Pretreatment Procedures to Limit Membrane Fouling in Reverse Osmosis Reclamation of Secondary Sewage Effluents,
W83-02849 5D

DECOOK, K. J.
Hydrological and Environmental Controls on Water Management in Semiarid Urban Areas -- Phase II,
W83-02918 4D

DELANEY, D. F.
Hydrologic Data of the Lower Merrimack River Basin, Massachusetts, from Concord River, Lowell, to Plum Island, Newburyport,
W83-02994 7C

DELMAS, R.
Chemistry of South Polar Snow,
W83-03119 2K

DELPRETE, A.
Lake Ontario Sediment-Mirex Relationships,
W83-02823 5B

DEMISSIE, M.
Hydrology, Hydraulics, and Sediment Transport, Kankakee and Iroquois Rivers,
W83-02921 2J

DEMKE, K. A.
Costs for Supplying Alternative Community Water and Sanitation Systems in Brazil,
W83-03092 6C

DENNIS, B.
Statistics of Species Abundance Distributions in Monitoring Aquatic Communities,
W83-03035 5C

DEWALLE, D. R.
Nature and Extent of Acid Snowpacks in Pennsylvania,
W83-02943 2C

DEYO, A. E.
Salinity Investigations in West Salt Creek, Colorado,
W83-02925 5B

DICK, R. I.
Process Integration in Sludge Management,
W83-03135 5E

DIETRICH, W. E.
Settling Velocity of Natural Particles,
W83-02939 2J

DIGIANO, F. A.
Characterization and Treatability of the By-Products of Chlorination of Naturally Occurring Humic Substances,
W83-03106 5F

Effect of Ozonation on the Biodegradability and Adsorbability of Specific Organics to be Removed in the 'Biologically Activated Carbon (BAC)' Process,
W83-03107 5D

DIRICKX, J.
Application to Rivers and Underground Waters,
W83-02866 5G

DIXON, D. R.
Water and Wastewater Treatment With Reusable Magnetite Particles,
W83-02852 5D

DOLAN, D. M.
Mass Balance Modeling of Heavy Metals in Saginaw Bay, Lake Huron,
W83-02820 5B

DONNELLY, J. A.
The Enumeration of Streptococci and Mycobacteria Present in Landfill Leachate,
W83-02885 5B

The Survival of Bacterial Indicators in Lysimeters and Landfills,
W83-02886 5E

DORSEY, P.
A Model of Costs for Treating Drinking Water,
W83-03089 5F

DOWD, J. F.
Radium, Thorium and Radioactive Lead Isotopes in Groundwaters: Application to the in Situ Determination of Adsorption-Desorption Rate Constants and Retardation Factors,
W83-02937 2K

DRELLACK, S. L. JR
Geologic and Well-Construction Data for the H-7 Borehole Complex Near the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-02977 4B

DUARTE, A. C.
Inhibition Modeling In Anaerobic Digestion,
W83-03126 5D

DUFFY, P. D.
Organic Carbon and Oxygen Demand Relationships in Stormflow From Southern Pine Watersheds,
W83-03015 5B

DUFOUR, A. P.
Drinking Water and Legionnaires' Disease,
W83-03067 5F

DUGAS, R.
The Measurement of Total Phosphorus in Waste Water (Le Dosage du Phosphore Total Dans Les Eaux Usees),
W83-02816 5A

DUNFORD, W. E.
Changes in Abundance and Growth Characteristics of White Perch From the Mouth of the Bay of Quinte,
W83-02808 6G

EAGLE, G. A.
A Chemical Investigation of a Marine Sewage Outfall,
W83-02888 5B

Nutrient-Salinity Relationships in Four Estuaries of the Cape Province, South Africa,
W83-02889 5B

EBERLE, S. H.
Theme 4: Technology Transfer: Report of the Session Convenor,
W83-02872 5D

ECKENFELDER, W. W. JR.
The Role of Consultants,
W83-02860 5D

EIBENSCHUTZ, J.
Geothermal Resources in the Northwestern Border (Recursos Geothermicos en la Frontera Noroccidental),
W83-03021 2F

ELORANTA, P. V.
Physical and Chemical Properties of Pond Waters Receiving Warm-Water Effluent from a Thermal Power Plant,
W83-02954 5C

ENGLANDE, A. J.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W83-02887 5B

ENGLEBRECHT, R. S.
Comparative Inactivation of Six Enteroviruses by Ozone,
W83-03068 5F

ETKIN, H.
Calibration and Field Testing of a Two-Probe Gamma Gauge,
W83-02964 7B

EVANGELOU, V. P.
Salinity Investigations in West Salt Creek, Colorado,
W83-02925 5B

Salt Generation in Pyritic Coal Spoils and its Effect on Saturated Hydraulic Conductivity,
W83-03024 5B

EVANS, R.
Waste From the Water Treatment Plant at Alton and Its Impact on the Mississippi River,
W83-02920 5E

EVANS, R. G.
Defining Cost-Effective Salinity Control Programs,
W83-02829 5G

EVANS, S. D.
A Water Use Comparison Between Corn and Sunflower,
W83-02828 2I

FEDERICI, J. M.
Application of Numerical Simulation Techniques to Floodplain Management,
W83-02893 2E

FELTIS, R. D.
Streamflow Losses to Madison Group Rocks in the Little Belt and Big Snowy Mountains, Montana,
W83-02974 2E

FELTON, S. P.
Identification of Total and Biologically Sensitive Forms of Toxic Metal Inputs to an Urban Affected River,
W83-03105 5A

FENTON, T. E.
Stratigraphy and Water Table Relationships of Upland Loess-Derived Soils in South-Central Iowa,
W83-02998 2G

FERGUSON, G. E.
Problems, Issues, Constraints, and Barriers to Water Quality Planning and Management in Urban and Urbanizing Areas (SMSA's) in Tennessee,
W83-02899 6B

FERRARA, R. A.
A Modeling Approach for Storm Water Quantity and Quality Control Via Detention Basins,
W83-03147 5G

FESTY, B.
Sanitary Problems in Relationship With Tap Water Distributed in New or Recent Buildings of Paris (Problems Sanitaires Poses A Paris Par L'Eau Potable Dans Les Immeubles Neufs Ou Recents),
W83-02844 5F

FISHER, J. S.
A Study of the Bed-Load Yield From a Watershed,
W83-03096 2J

FLINSPACH, D.
Significance on the New Large Water Reservoir Schonbuhl and Its Consequences on the Landeswasserversorgung Stuttgart (Die Bedeutung Des Neuen Grossbehalters Schonbuhl Fur Die Landeswasserversorgung Stuttgart),
W83-02963 8A

FONTAINE, J.
Water and Air Renewal in Reservoirs (Les Reservoirs D'eau Potable. 1-Le Renouvellement Methodique de L'eau et de L'air Dans les Reservoirs),
W83-02815 5G

FONTAINE, R. A.
Floods in Maine, April-May 1979,
W83-02983 2E

FORDHAM, J. W.
Application of Numerical Simulation Techniques to Floodplain Management,
W83-02893 2E

FORNEY, J. C.
Organochlorine and Heavy Metal Residues in Standard Fillets of Coho and Chinook Salmon of the Great Lakes - 1980,
W83-02843 5C

FORSHAUG, J. M.
Metabolic Properties of Thiobacillus ferrooxidans Isolated from Neutral pH Mine Drainage,
W83-03045 5B

FORTSON, J. C.
Stream Temperature Under an Inadequate Buffer Strip in the Southeast Piedmont,
W83-03149 6G

FRANKENBERGER, W. T. JR
Bacterial Utilization of Simple Alcohols and Their Influence on Saturated Hydraulic Conductivity,
W83-03014 2G

FRENCH, R. H.
Turbulent Vertical Momentum Transfer in Stratified Environments,
W83-02901 2E

FRENKEL, H.
Infiltration as Affected by Long-Term Use of Sodic-Saline Water for Irrigation,
W83-03016 3C

FRICKEL, D. G.
Methodology for Hydrologic Evaluation of a Potential Surface Mine: Loblolly Branch Basin, Tuscaloosa County, Alabama,
W83-02976 6G

FRIMMEL, F. H.
Metal Ion Complexation by Aquatic Humus. III. Model Development and Relation to Surface Water. (Komplexierung Von Metallionen Durch Gewasserhuminstoffe. III. Modellentwicklung und Gewasserbezug),
W83-02818 5B

FRIND, E. O.
Contaminant Transport in Fractured Porous Media: Analytical Solutions for a System of Parallel Fractures,
W83-02933 5B

FUENTES, R. F.
Hydrologic Characteristics of Surface-Mined Land Reclaimed by Sludge Irrigation, Fulton County, Illinois,
W83-02975 5A

GALLOP, R. A.
The Exhaustive Reuse of Water in Food Processing,
W83-02884 3E

GAMESON, A. L. H.
Application to Estuarine and Coastal Waters,
W83-02865 5B

GANGAWARE, T. R.
Problems, Issues, Constraints, and Barriers to Water Quality Planning and Management in Urban and Urbanizing Areas (SMSA's) in Tennessee,
W83-02899 6B

GARDINER, B. N.
Hydrodynamic Dispersion During Unsteady, Unsaturated Water Flow in a Clay Soil,
W83-03001 2G

GARTON, J. E.
Irrigation Water Management for Wide-Spaced Furrow Irrigation,
W83-03037 3F

GAY, F. B.
Hydrologic Data of the Lake Cochituate Drainage Basin, Framingham-Natick, Massachusetts,
W83-02989 7C

Hydrologic Data of the Lower Merrimack River Basin, Massachusetts, from Concord River, Lowell, to Plum Island, Newburyport,
W83-02994 7C

GELDENHUYS, D.
Research Into the Mass Culture of Algae in Closed Systems,
W83-02854 5D

GERBER, A.
The Use of Mathematical Models in the Formulation of Pollution Control Policies - An Overview,
W83-02864 5

GIAQUINTA, A. R.
Toxic Substance Models for the Upper Mississippi and Missouri Rivers,
W83-03114 5B

GILBERT, B. K.
Water-Data Program of the U.S. Geological Survey,
W83-02967 7A

GILROY, E. J.
Design of Surface-Water Data Networks for Regional Information,
W83-02970 7A

GOLD, R. L.
Techniques for Estimating Flood Discharges for Unregulated Streams in New Mexico,
W83-02981 2E

GOLLEHON, N. R.
Is the Ogallala Going Dry.
W83-02839 3F

GOODGAME, T. H.
Leaching Characteristics of Industrial Metal Finishing Wastewater Treatment Plant Solids,
W83-03122 5E

GRAUSTEIN, W. C.
Radium, Thorium and Radioactive Lead Isotopes in Groundwaters: Application to the in Situ Determination of Adsorption-Desorption Rate Constants and Retardation Factors,
W83-02937 2K

GRAY, W. G.
Derivation of Vertically Averaged Equations Describing Multiphase Flow in Porous Media,
W83-02930 2F

GREENBERG, M.
Maximum Contaminant Levels for Toxic Substances in Water: A Statistical Approach,
W83-03145 5A

GREENWALT, R.
Runoff and Soil Erosion on Frozen Soils in Northeastern Oregon,
W83-02826 2J

GREGOR, D. J.
Data Filtering for Large Area Analysis-An Example From the Canadian Nearshore Zone of the Great Lakes,
W83-03085 7C

GRIMVALL, A.
Modified Stripping Technique for the Analysis of Trace Organics in Water,
W83-03131 5A

GROVES, G. R.
The Performance of an Ultrafiltration Pilot-Plant for the Closed Loop Recycling of Textile Desizing Effluents,
W83-03123 5D

GRUBB, H. F.
Aquifer Test Results, Green Swamp Area, Florida,
W83-02980 2F

GUARNERI, B.
Atypical Mycobacteria Isolated at Catania (Microbatteri Atipici Isolati a Catania),
W83-03009 5A

GUIRAUD, A.
History of Accidental Pollutions Which Have Occurred in the World (Historique des Pollutions Accidentelles Survenues Dans Le Monde),
W83-02817 5B

GUPTA, V. L.
Application of Numerical Simulation Techniques to Floodplain Management,
W83-02893 2E

HADAS, A.
Infiltration as Affected by Long-Term Use of Sodic-Saline Water for Irrigation,
W83-03016 3C

HANSEN, S. R.
The Striped Bass Decline in the San Francisco Bay-Delta Estuary,
W83-02919 5C

HANSON, R. L.
Evapotranspiration Before and After Clearing Phreatophytes, Gila River Flood Plain, Graham County, Arizona,
W83-02966 2D

HARTIG, J. H.
Organochlorine and Heavy Metal Residues in Standard Fillets of Coho and Chinook Salmon of the Great Lakes - 1980,
W83-02843 5C

HASIT, Y.
Process Integration in Sludge Management,
W83-03135 5E

HASKELL, C. R.
Floods in Maine, April-May 1979,
W83-02983 2E

HATFIELD, J. L.
Spatial Variability of Surface Temperature Along Two Transects of a Bare Soil,
W83-02940 2G

HAUG, R. T.
Thermal Pretreatment of Sludges--A Field Demonstration,
W83-02831 5E

HAWERMAN, B.
Legal and Administrative Aspects,
W83-02874 5G

HAYASHI, K.
Opening of a Fault and Resulting Slip Due to Injection of Fluid for the Extraction of Geothermal Heat,
W83-03132 4B

HAYMES, G. T.
Changes in Abundance and Growth Characteristics of White Perch From the Mouth of the Bay of Quinte,
W83-02808 6G

HAZAN, A.
Calibration and Field Testing of a Two-Probe Gamma Gauge,
W83-02964 7B

HEATON, R. D.
Water Recycling Systems,
W83-02878 3D

HEDMAN, E. R.
Streamflow Characteristics Related to Channel Geometry of Streams in Western United States,
W83-02969 2E

HEDSTROM, W. E.
Improving Design of a Domestic Waste Disposal System Using an Unsaturated Flow Model and Phosphorus Adsorption,
W83-02900 5D

HEIDARI, M.
Application of Linear Systems Theory and Linear Programming to Ground Water Management in Kansas,
W83-03142 4B

Water Quality Modeling of the Equus beds Aquifer in South Central Kansas,
W83-03042 5B

HEIDTKE, T. M.
Effectiveness of Treatment to Meet Phosphorus Objectives in the Great Lakes,
W83-02830 5G

HEIST, J. A.
Design and Evaluation of an AFVC Wash Column With Direct Melting on the Ice Plug,
W83-03040 3A

HELBIG, J.
Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Water with the Aid of Incubation Experiments. Part 1: Determination of Rates of Phosphorus and Iron Release (Bestimmung von Nahrstoff- und Metall-Freisetzungsraten aus Sedimenten Umweltbelasteter Fliessgewasserstauhaltungen mit Hilfe von Inkubationsversuchen. Teil 1: Bestimmung von Phosphor- und Eisenfreisetzungsraten),
W83-03053 5B

Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Waters with the aid of Incubation Experiments. Part 2: Investigations on Nitrogen and Manganese Release (Bestimmung Von Nahrstoff- Und Metallfreisetzungsraten Aus Sedimenten Unweltbelasteter Fliessgewasserstau-Haltungen Mit Hilfe Von Inkubationsversuchen. Teil 2: Untersuchungen Zur Stickstoff-Und Manganfreisetzung),
W83-03052 5B

HELWEG, O. J.
Optimal Design of Small Reservoir Systems,
W83-02836 3B

HELZ, G. R.
EDTA as a Kinetic Inhibitor of Copper(II) Sulfide Precipitation,
W83-02956 5B

HEMYARI, P.
Water Management and Salinity Control in Irrigated Swelling and Shrinking Soils,
W83-03038 3F

HERBSLEB, G.
Corrosion Behavior of Passivatable Stainless Steel Under Reducing Conditions with Simultaneous Abrasive Stress (Das Korrosionsverhalten Passivierbarer Nichtrostender Stahle in Wassern Unter Reduzierenden Bedingungen Bei Gleichzeitiger Abrasiver Beanspruchung),
W83-03047 8G

HERDENDORF, C. E.
Large Lakes of the World,
W83-03078 2H

HEROES, D. V.
Removal of Pesticides and Herbicides by Means of Adsorption on Activated Carbon,
W83-02857 5G

HEROLD, C. E.
Mineralization Problems in the PWV Complex - The Identification of Viable Solutions by Means of a Suite of Mathematical Models,
W83-02881 5G

HERRLING, B.
Coupling of One- and Two-Dimensional Finite Elements for the Computation of Tidal Flow in Estuaries,
W83-03051 2L

HEUSCHELE, A. S.
Retention of Benthic Invertebrates With Different Sieving Techniques,
W83-02825 2H

Vertical Distribution of Profundal Benthos in Lake Superior Sediments,
W83-02822 2H

HEWLETT, J. D.
Stream Temperature Under an Inadequate Buffer Strip in the Southeast Piedmont,
W83-03149 6G

HICKCOX, D. H.
The Impact of Energy Development in the Tongue River Basin, Southeastern Montana,
W83-03139 4C

HILDICK-SMITH, A.
A Modeling Approach for Storm Water Quantity and Quality Control Via Detention Basins,
W83-03147 5G

HILL, D. C.
Statewide Evaluation of Trace Element Accumulation From Long Term Disposal of Waste Water,
W83-02892 3C

HILL, T.
Waste From the Water Treatment Plant at Alton and Its Impact on the Mississippi River,
W83-02920 5E

HODGES, M. E.
Irrigation Water Management for Wide-Spaced Furrow Irrigation,
W83-03037 3F

HODSON, R. E.
Microbial Degradation of Natural and Pollutionally-Derived Lignocellulosic Detritus in Wetland Ecosystems,
W83-02913 5B

HOFFMAN, R. W.
An in Situ Comparison of the Effectiveness of Four Algicides,
W83-03137 5D

HOIGNE, J.
Rate Constants of Reactions of Ozone with Organic and Inorganic Compounds in Water--I. Non-Dissociating Organic Compounds,
W83-02950 5F

Rate Constants of Reactions of Ozone With Organic and Inorganic Compounds in Water--II. Dissociating Organic Compounds,
W83-02951 5F

HOLLAND, R.
Energy for Rural Development,
W83-03008 8C

HOLZIG, R.
Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Water with the Aid of Incubation Experiments. Part 1: Determination of Rates of Phosphorus and Iron Release (Bestimmung von Nahrstoff- und Metall-Freisetzungsraten aus Sedimenten Umweltbelasteter Fliessgewasserstauhaltungen mit Hilfe von Inkubationsversuchen. Teil 1: Bestimmung von Phosphor- und Eisenfreisetzungsraten),
W83-03053 5B

Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Waters with the aid of Incubation Experiments. Part 2: Investigations on Nitrogen and Manganese Release (Bestimmung Von Nahrstoff- Und Metallfreisetzungsraten Aus Sedimenten Unweltbelasteter Fliessgewasserstau-Haltungen Mit Hilfe Von Inkubationsversuchen. Teil 2: Untersuchungen Zur Stickstoff-Und Manganfreisetzung),
W83-03052 5B

HOPKINS, G. D.
Volatilization of Organic Trace Contaminants by Air Stripping for Water Reclamation,
W83-02917 5D

HOPKINS, G. J.
A Ten-year Study of Phytoplankton Biomass and Composition in the Nanticoke Region of Long Point Bay, Lake Erie,
W83-03080 2H

HORZEMPA, L. M.
EDTA as a Kinetic Inhibitor of Copper(II) Sulfide Precipitation,
W83-02956 5B

HOUCK, M. H.
Management of Existing Reservoir Systems by Interactive Optimization,
W83-02924 6A

HOWELL, P. D.
Updip Delineation of the Tertiary Limestone Aquifer, South Carolina,
W83-02896 2F

HUANG, C.
A Numerical Study of Raindrop Impact Phenomena: The Rigid Case,
W83-03029 2J

HUBERT, W. A.
Biological and Recreational Aspects of Water Level Management for Clear Lake, Iowa,
W83-03036 6G

HUDGINS, R. R.
Suppression of Density Waves in Clarifiers,
W83-02880 8B

HUGHES, J.
The Legislative Reality of a National Water Policy,
W83-02923 6E

HULLINGER, D.
Waste From the Water Treatment Plant at Alton and Its Impact on the Mississippi River,
W83-02920 5E

HYDAMAKA, A. W.
The Exhaustive Reuse of Water in Food Processing,
W83-02884 3E

IBIDAPO-OBE, O.
Contemporary Stochastic Approach to Water Resource Systems: The ARMP and Feature Prediction Models,
W83-03060 2A

IMHOFF, K. R.
Water Recycling - Industrial Applications,
W83-02879 3E

INOUYE, C. A.
Trace Metal Complexation by Fulvic Acid Extracted from Sewage Sludge: II. Development of Chemical Models,
W83-03030 5B

INSALACO, S. E.
The Influence of Sex, Size, and Season on Mirex Levels Within Selected Tissues of Lake Ontario Salmon,
W83-02841 5C

ISQUITH, I.
Microbial Analysis of Domestic Cistern Water in the U. S. Virgin Islands,
W83-03099 5F

Microbial Quality of Water in Old Wells and the Public Water Distribution System in the U. S. Virgin Islands,
W83-03098 5F

IZBICKI, J.
Nature and Extent of Acid Snowpacks in Pennsylvania,
W83-02943 2C

JACKSON, W. L.
Runoff and Water Quality From Three Soil Landform Units on Mancos Shale,
W83-03150 2J

JAKUBOWSKI, W.
Drinking Water and Legionnaires' Disease,
W83-03067 5F

JALALI-YAZDI, Y.
Coagulation and Removal of Algal Suspensions From Wastewater Stabilization Ponds,
W83-02903 5D

JAMES, A.
Mathematical Modelling of Estuaries and Coastal Waters,
W83-02867 2L

JANKE, A. C.
Effects of Farming Practices on Sediment in Irrigation Return Flow,
W83-03039 4D

JARRELL, W. M.
Combined Water-Fertilizer Management to Minimize Non-Point Water Pollution While Achieving High Crop Production,
W83-02907 2I

JENKINS, D.
The Effect of Aeration Basin Configuration on Activated Sludge Bulking at Low Organic Loading,
W83-03120 5D

JENKINS, T.
Transport of Water in Frozen Soil: I. Experimental Determination of Soil-Water Diffusivity Under Isothermal Conditions,
W83-03054 2C

JOHNSON, B. S.
Midseason Soil Water Recharge for Corn in the Northwestern Corn Belt,
W83-02890 2G

JONES, E. B.
Soil Moisture Variation Patterns Observed in Hand County, South Dakota,
W83-03138 2G

JONES, P. H.
Theme 5: Water Pollution Control in Developing Countries: Report of the Session Convenor,
W83-02873 6F

JOSHI, D. C.
Sedimentation and its Control in Nadis in the Indian Arid Zone - a Case Study,
W83-03133 2J

JUDE, D. J.
A Saponification Procedure for the Determination of Some Chlorinated Hydrocarbons in Fish,
W83-03077 5A

JULANDER, R. P.
Runoff and Water Quality From Three Soil Landform Units on Mancos Shale,
W83-03150 2J

KABELITZ, K. R.
Guidelines for the Reduction of Wastewater Tax (Hinweise zur Reduzierung Der Abwasserabgabe),
W83-02801 6F

KAHL, J. S.
Metal Input and Mobilization in Two Acid-Stressed Lake Watersheds in Maine,
W83-02891 5B

KALAS, L. L.
Calcium Carbonate in Postglacial Lake Erie Sediment,
W83-02809 2J

KAMMERER, P. A. JR
Aquatic Biology in Nederlo Creek, Southwestern Wisconsin,
W83-02978 6G

KANG, S. W.
Wave Action and Bottom Shear Stresses in Lake Erie,
W83-03073 2H

KARLINGER, M. R.
Design of Surface-Water Data Networks for Regional Information,
W83-02970 7A

KARP, A. W.
Building Water and Sanitation Projects in Rural Guatemala,
W83-03071 5F

KARSTEN, R. A.
Hydrology of the Surficial Aquifer in the Floyd River Basin, Iowa,
W83-02993 2F

KASPRZYK, R.
Turbidity in the Western Basin of Lake Erie,
W83-03118 2J

KAWAHARA, M.
Stream Function Finite Elements for Nearshore Current,
W83-03064 2L

KEINATH, T. M.
Mechanism of Clarification Failure,
W83-02807 5D

KEIZER, H. I.
Shore Protection in the Town of Stoney Creek, Southwest Lake Ontario, 1934-1979: Historical Changes and Durability of Structures,
W83-02842 4D

KENNEDY, C. W.
Sorption and Sedimentation of Zn and Cd by Seston in Southern Lake Michigan,
W83-03083 5B

KENT, D. C.
Assessment of Economic, Social, and Institutional Impacts of Ground-Water Regulation of the Tillman Terrace Aquifer in Southwestern Oklahoma,
W83-03033 4B

KIEFHABER, K. P.
Flotation as the Final Clarification Step in Waste-Water Treatment and its Influence on the Oxygen Balance of Receiving Waters,
W83-02848 5D

KING, L. G.
Effects of Farming Practices on Sediment in Irrigation Return Flow,
W83-03039 4D

KIPPLE, F. P.
Evapotranspiration Before and After Clearing Phreatophytes, Gila River Flood Plain, Graham County, Arizona,
W83-02966 2D

KLEMETSON, S. L.
Solar Heating of Wastewater Stabilization Ponds,
W83-03100 5D

KLING, G. F.
Overland Flow From Sloping Land: Effects of Perched Water Tables and Subsurface Drains,
W83-03028 4A

KNIGHT, J. H.
Absorption of Water by Soil: The Effect of a Surface Crust,
W83-02997 2G

KNIGHT, N. J.
Instream Flow Requirements of Native California Stream Fishes,
W83-02906 6G

KNOCH, B. D.
Modeling Direct Recharge of Surficial Aquifers,
W83-03101 2F

KOCHER, W. M.
Response of Methane Fermentation Systems to Industrial Toxicants,
W83-02833 5D

KOLARIK, L. O.
Colour and Turbidity Removal With Reusable Magnetite Particles--IV. Alkali Activated Magnetite--A New Solid, Reusable Coagulant-Adsorbent,
W83-02948 5F

Water and Wastewater Treatment With Reusable Magnetite Particles,
W83-02852 5D

KOOPMAN, B. L.
The Effect of Aeration Basin Configuration on Activated Sludge Bulking at Low Organic Loading,
W83-03120 5D

KOSACHEVSKAYA, P. I.
Hygienic Evaluation of Water Polluted by Pesticides Entering Water Bodies in Surface Runoff (Gigienicheskaya Otsenka Vody, Zagryaznennoi Nekotorymi Pestitsidami Pri Postuplenii Ikh V Vodoem S Poverkhnostnym Stokom),
W83-03017 5C

KOSSLER, E.
Installed and Planned Mini Hydro,
W83-03007 8C

KOWALSKI, E.
Nitrification Process in a Packed Bed Reactor With a Chemically Active Bed,
W83-02947 5D

KRENKEL, P. A.
The Use of Water Quality Models in Management Decision Making,
W83-02847 5G

KRISHNASWAMI, S.
Radium, Thorium and Radioactive Lead Isotopes in Groundwaters: Application to the in Situ Determination of Adsorption-Desorption Rate Constants and Retardation Factors,
W83-02937 2K

KUAN, S. -P.
Sediment Transport in Alluvial Channels: Rates for Erosion and Deposition of Cohesive Sediments Literature Review and Experimental Design,
W83-03032 2J

KUCHENRITHER, R. D.
Mortality Patterns of Indicator Organisms During Aerobic Digestion,
W83-02834 5E

KUGEL, G.
Simultaneous Pasteurization - Digestion (SPD-Process),
W83-03125 5D

KUNIANSKY, E. L.
Aquifer Parameter Prediction by Numerical Modeling,
W83-02912 2F

KUZNIA, C. P.
Computer Control in a Biological Sewage Plant, Methods and Experience,
W83-02851 5D

KWIATKOWSKI, R. E.
Trends in Lake Ontario Surveillance Parameters, 1974-1980,
W83-02840 2H

LAM, A. W.
Exposure to Microbial Aerosols From Activated Sludge Treatment,
W83-03097 5D

LANE, D. D.
Transport Modeling of an Agricultural Pesticide, Phase I,
W83-03043 5B

LANSFORD, R. R.
Is the Ogallala Going Dry.
W83-02839 3F

LANTZ, R. B.
Numerical Simulation of Flow and Contaminant Migration at an Extensively Monitored Landfill,
W83-02942 5B

LAQUIDARA, V. D.
Mechanism of Clarification Failure,
W83-02807 5D

LARSON, C. L.
Modeling Direct Recharge of Surficial Aquifers,
W83-03101 2F

LATINOPOULOS, P.
Well Recharge in Idealized Rectangular Aquifers,
W83-03056 4B

LAURENT, A. M.
Sanitary Problems in Relationship With Tap Water Distributed in New or Recent Buildings of Paris (Problems Sanitaires Poses A Paris Par L'Eau Potable Dans Les Immeubles Neufs Ou Recents),
W83-02844 5F

LAURIA, D. T.
Costs for Supplying Alternative Community Water and Sanitation Systems in Brazil,
W83-03092 6C

LAWSON, D. E.
Mobilization, Movement and Deposition of Active Subaerial Sediment Flows, Matanuska Glacier, Alaska,
W83-03116 2J

LAYE, J.
Supply of a Rural Community in the Rhone Department by Means of Mid-Depth Drilling in the 'Molasse' of the Bas-Dauphine (Alimentation D'Une Commune Rurale Du Department Du Rhone Au Moyen D'Un Forage De Profondeur Moyenne Dans La ('Molasse' Du Bas-Dauphine),
W83-02845 3B

LEA, C.
A Ten-year Study of Phytoplankton Biomass and Composition in the Nanticoke Region of Long Point Bay, Lake Erie,
W83-03080 2H

LEACH, S. D.
Estimated Water Use in Florida, 1980,
W83-02990 6D

LEBRUN, T. J.
Thermal Pretreatment of Sludges--A Field Demonstration,
W83-02831 5E

LEE, B. J.
Ten Ecosystem Approaches to the Planning and Management of the Great Lakes,
W83-03082 6A

LEE, S. -E.
The Effect of Aeration Basin Configuration on Activated Sludge Bulking at Low Organic Loading,
W83-03120 5D

LEFROU, C.
Balancing Benefits and Expenditure in Water Pollution Control,
W83-02862 6B

LEFTWICH, D. B.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W83-02887 5B

LEGRAND, M.
Chemistry of South Polar Snow,
W83-03119 2K

LEONARDI, G.
Atypical Mycobacteria Isolated at Catania (Microbatteri Atipici Isolati a Catania),
W83-03009 5A

LEPRETRE, A.
Telecontrol and the Computer in Water Supply (Telesurveillance Et Ordinateur Au Service Des Eaux),
W83-02846 5F

LETEY, J.
Combined Water-Fertilizer Management to Minimize Non-Point Water Pollution While Achieving High Crop Production,
W83-02907 2I

LETTERMAN, R. D.
Effect of Solution Chemistry on Coagulation with Hydrolyzed Al(III): Significance of Sulfate Ion and pH,
W83-02949 5F

LEWANDOWSKI, Z.
Nitrification Process in a Packed Bed Reactor With a Chemically Active Bed,
W83-02947 5D

LEWIN, J.
Transport of Heavy Metals on Suspended Sediments Under High Flow Conditions in a Mineralized Region of Wales,
W83-03048 5B

LEWIS, R. E.
Geothermal Resources in the Banbury Hot Springs Area, Twin Falls County, Idaho,
W83-02972 2F

LEWIS, R. F.
The Effect of Aeration Basin Configuration on Activated Sludge Bulking at Low Organic Loading,
W83-03120 5D

LICK, W.
Turbidity in the Western Basin of Lake Erie,
W83-03118 2J

Wave Action and Bottom Shear Stresses in Lake Erie,
W83-03073 2H

LIDWIN, R. A.
Aquatic Biology in Nederlo Creek, Southwestern Wisconsin,
W83-02978 6G

LINDENBERG, H.
Modern Information Systems for Water Supply Companies-Requirements and Functions (Moderne Informationssysteme Fur Wasserwarten - Anforderungen Und Funktionen),
W83-03058 7A

LINDSTROM, M. J.
A Water Use Comparison Between Corn and Sunflower,
W83-02828 2I

LINSTEDT, K. D.
Water Recycling: Review and Background,
W83-02877 3E

LIPPY, E. C.
The Role of Filtration in Preventing Waterborne Disease,
W83-03088 5F

LISLE, T. E.
Effects of Aggradation and Degradation on Riffle-Pool Morphology in Natural Gravel Channels, Northwestern California,
W83-02936 2J

LITTLE, M. D.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W83-02887 5B

LJUNGKULL, J. E.
An Experimental Investigation of Evapotranspiration Estimation Methods,
W83-03034 2D

LOGSDON, G. S.
The Role of Filtration in Preventing Waterborne Disease,
W83-03088 5F

LONG, R. B.
The Potential Impact of Water Reallocations on Agriculture in Idaho,
W83-03143 6B

LORENZO, M. F.
Effect of Ozonation on the Biodegradability and Adsorbability of Specific Organics to be Removed in the 'Biologically Activated Carbon (BAC)' Process,
W83-03107 5D

LOUCKS, D. P.
Methods for Deriving Operating Rule Curves for Multiple Reservoir Systems,
W83-03094 4A

LOWERY, B.
Overlanć Flow From Sloping Land: Effects of Perched Water Tables and Subsurface Drains,
W83-03028 4A

LUND, S. W.
Soil Conservation in the Coon Creek Basin, Wisconsin,
W83-02827 4D

LUSHER, J. A.
Funding Water Pollution Control in South Africa,
W83-02870 6F

LYONS, B. J.
An Integrated Low Cost System for Treatment of Potato Processing Wasterwater Incorporating Anaerobic Fermentation and Phosphorus Removal,
W83-03124 5D

MACCUBBIN, A. E.
Microbial Degradation of Natural and Pollution-ally-Derived Lignocellulosic Detritus in Wetland Ecosystems,
W83-02913 5B

MACLEAN, N. G.
Ultrasonic Telemetry Studies of Fish Activity Near the Nanticoke Thermal Generating Station,
W83-03074 5C

MAKAREWICZ, J. C.
The Influence of Sex, Size, and Season on Mirex Levels Within Selected Tissues of Lake Ontario Salmon,
W83-02841 5C

MALLE, K. -G.
Contents of Metals and Suspended Solids in the Rhine (Metallgehalt und Schwebstoffgehalt im Rhein),
W83-02813 5B

The Successes of Increased Wastewater Treatment Plant Construction on the Rhine (Erfolge Verstarkten Klaranlagenbaus Am Rhein),
W83-02802 5G

MANAHAN, S. E.
A Simplified Scheme for the Analysis of Pollutants in Groundwater and Leachates Contaminated by Hazardous Chemicals,
W83-02904 5A

MAPP, H. P.
Assessment of Economic, Social, and Institutional Impacts of Ground-Water Regulation of the Tillman Terrace Aquifer in Southwestern Oklahoma,
W83-03033 4B

MARIVOET, J. L.
Application to Rivers and Underground Waters,
W83-02866 5G

MARKS, D. H.
Agricultural Vs. Hydropower Tradeoffs in the Operation of the High Aswan Dam,
W83-02934 6B

MAROTZ, G. A.
Variations in Groundwater Quality with Drought,
W83-03044 5B

MARRANZANO, M.
Atypical Mycobacteria Isolated at Catania (Microbatteri Atipici Isolati a Catania),
W83-03009 5A

MARSHALL, J. S.
Sorption and Sedimentation of Zn and Cd by Seston in Southern Lake Michigan,
W83-03083 5B

MARTIN, G.
Elements of the Inhibition of Nitrifying Bacteria,
W83-03127 5D

MARTIN, P.
Dam and River Sand-Drifting Inspection (La Bathymetrie--Technique De Surveillance De L'Ensablement Des Fleuves Et Des Retenues),
W83-02961 2J

MASON, J. W.
Aquatic Biology in Nederlo Creek, Southwestern Wisconsin,
W83-02978 6G

MAY, S. C.
Energy Recovery From the Reject Brine of Reverse Osmosis Systems,
W83-03113 3A

MAZAEV, V. T.
Pollution of Ground Waters by Chlorocholine Chloride Used in Agriculture (Voprosy Zagryazneniya Gruntovykh Vod Pri Primenenii Khlorkholinkhlorida V Selyskom Khozyaistve),
W83-03011 5B

MCCALL, E. C.
Transport Modeling of an Agricultural Pesticide, Phase I,
W83-03043 5B

MCCUTCHEON, S. C.
Turbulent Vertical Momentum Transfer in Stratified Environments,
W83-02901 2E

MCELWEE, C. D.
Water Quality Modeling of the Equus beds Aquifer in South Central Kansas,
W83-03042 5B

MCGEE, M. V.
The Influence of Water Exchange On Water Quality and Fish Production in Channel Catfish Ponds,
W83-02905 5G

MCGHEE, T. J.
Use of EPA's CAPDET Program for Evaluation of Wastewater Treatment Alternatives,
W83-02804 5D

MCGREGOR, K. M.
Variations in Groundwater Quality with Drought,
W83-03044 5B

MCKIM, H. L.
Microbiological Aerosols From a Field-Source Wastewater Irrigation System,
W83-02835 5B

MCLEAN, D. D.
Biological and Recreational Aspects of Water Level Management for Clear Lake, Iowa,
W83-03036 6G

MCMAHON, B. R.
A Kinetic Model of Steady State Phosphorus Fixation in a Batch Reactor--IV,
W83-02952 5D

MCMAHON, T. A.
Evaluation of Rapid Reservoir Storage-Yield Procedures,
W83-03061 4A

MCMILLAN, J. D.
Improving Design of a Domestic Waste Disposal System Using an Unsaturated Flow Model and Phosphorus Adsorption,
W83-02900 5D

MCNAMARA, J. N.
The Influence of Sex, Size, and Season on Mirex Levels Within Selected Tissues of Lake Ontario Salmon,
W83-02841 5C

MCNUTT, J. L.
Granular Activated Carbon and Preozonated Granular Activated Carbon Treatment for Biologically and Physically-Chemically Treated Wastewater Effluents,
W83-03128 5D

MCSHANE, S. F.
Effect of Ozonation on the Biodegradability and Adsorbability of Specific Organics to be Removed in the 'Biologically Activated Carbon (BAC)' Process,
W83-03107 5D

MEADE, R. H.
Sources, Sinks, and Storage of River Sediment in the Atlantic Drainage of the United States,
W83-03117 2J

MEDINA, M. A. JR.
Hydrologic and Water Quality Modeling for Instream Flow Strategies,
W83-02927 6C

MEISSNER, U.
Collocation Formulations for the Finite Element Analysis of Tidal and Transport Processes in Estuaries,
W83-03055 2L

MELNIKOVA, A. I.
Sanitary Microbiologic Assessment of Water Desalination by Distillation (Sanitarno-Mikrobiologicheskaya Otsenka Distillyatsionnogo Metoda Opresneniya Vody),
W83-03010 3A

MENZ, F. C.
An Assessment of the Economic Magnitude of Environmental Damage From Acid Precipitation in the Adirondacks,
W83-03095 6B

MERILLON, Y.
History of Accidental Pollutions Which Have Occurred in the World (Historique des Pollutions Accidentelles Survenues Dans Le Monde),
W83-02817 5B

MEYER, M. J.
Hydrology of the Surficial Aquifer in the Floyd River Basin, Iowa,
W83-02993 2F

MEYERS, S.
Optimal Annual Operation of a Water Supply and Distribution System,
W83-03062 6A

MICHAUD, J. P.
Alum Control of Internal Phosphorus Loading in a Shallow Lake,
W83-03140 5G

MILLER, R. F.
Methodology for Hydrologic Evaluation of a Potential Surface Mine: Loblolly Branch Basin, Tuscaloosa County, Alabama,
W83-02976 6G

MILLER, R. J.
Salinity and Boron Control Under High-Frequency Low-Volume Irrigation,
W83-02908 5B

MILLER, T. J.
A Saponification Procedure for the Determination of Some Chlorinated Hydrocarbons in Fish,
W83-03077 5A

MILLER, T. S.
Geology and Ground-Water Resources of Oswego County, New York,
W83-02987 2F

MITCHELL, M. J.
Effect of Atmospheric Sulfur Pollutants Derived from Acid Precipitation on the Benthic Dynamics of Lakes,
W83-03093 5C

MIYAI, M.
Computation of the Index of Pollution Caused by Heavy Metals in River Sediment,
W83-03049 5B

MODESITT, D. E.
Wastewater Stabilization Lagoon Effluent Upgrading With Modified Intermittent Sand Filters,
W83-02902 5D

MOFFITT, L. J.
Benefits of Pollution Control on Massachusetts' Housatonic River: A Hedonic Pricing Approach,
W83-03141 6B

MOJGANI, P.
Use of EPA's CAPDET Program for Evaluation of Wastewater Treatment Alternatives,
W83-02804 5D

MONTOUT, G.
Sanitary Problems in Relationship With Tap Water Distributed in New or Recent Buildings of Paris (Problems Sanitaires Poses A Paris Par L'Eau Potable Dans Les Immeubles Neufs Ou Recents),
W83-02844 5F

MORAN, E. C.
Prediction of the Response of Pond Biota to Animal Waste Fertilization,
W83-03103 5C

MORGAN, W. D.
Water Conservation Kits: A Time Series Analysis of a Conservation Policy,
W83-03136 3D

MOSS, M. E.
Design of Surface-Water Data Networks for Regional Information,
W83-02970 7A

MOTSCHALL, R. M.
Pollution Potential Ranking of Barnyards for Priority Watershed Planning,
W83-02915 5G

MOYLE, P. B.
Instream Flow Requirements of Native California Stream Fishes,
W83-02906 6G

MUDROCH, A.
Calcium Carbonate in Postglacial Lake Erie Sediment,
W83-02809 2J

MULLEN, J. K.
An Assessment of the Economic Magnitude of Environmental Damage From Acid Precipitation in the Adirondacks,
W83-03095 6B

MULLER, G.
Contents of Metals and Suspended Solids in the Rhine (Metallgehalt und Schwebstoffgehalt im Rhein),
W83-02813 5B

MULLER, M. S.
The Impact of Diffuse Atmospheric Nutrient Loading on an Oligotrophic Freshwater Lake in a Developing Urban and Industrial Area (Richards Bay, South Africa),
W83-02850 5C

MUNZ, C.
Volatilization of Organic Trace Contaminants by Air Stripping for Water Reclamation,
W83-02917 5D

MURAISO, H.
Theoretical and Experimental Study of Factors Affecting Capillary Suction Time (CST),
W83-02955 5D

MURPHY, M. C.
Suppression of Density Waves in Clarifiers,
W83-02880 8B

MYRICK, R. M.
Evapotranspiration Before and After Clearing Phreatophytes, Gila River Flood Plain, Graham County, Arizona,
W83-02966 2D

NAIR, R.
Development Potential for Low-Head Hydro,
W83-03005 8C

NAKANO, Y.
Transport of Water in Frozen Soil: I. Experimental Determination of Soil-Water Diffusivity Under Isothermal Conditions,
W83-03054 2C

NARF, R. P.
Aquatic Biology in Nederlo Creek, Southwestern Wisconsin,
W83-02978 6G

NEAL, R. A.
Evaluating Potential Health Risks of Consuming Reused Water,
W83-03086 5C

NEIS, U.
Flotation as the Final Clarification Step in Waste-Water Treatment and its Influence on the Oxygen Balance of Receiving Waters,
W83-02848 5D

NELSON, W. W.
Midseason Soil Water Recharge for Corn in the Northwestern Corn Belt,
W83-02890 2G

NETZER, A.
Granular Activated Carbon and Preozonated Granular Activated Carbon Treatment for Biologically and Physically-Chemically Treated Wastewater Effluents,
W83-03128 5D

NEUBECKER, T. A.
The Measurement of Complexation Capacity and Conditional Stability Constants for Ligands in Natural Waters,
W83-02957 5A

NICKUM, J. G.
Biological and Recreational Aspects of Water Level Management for Clear Lake, Iowa,
W83-03036 6G

NIEMEIR, P. E.
Biological and Recreational Aspects of Water Level Management for Clear Lake, Iowa,
W83-03036 6G

NIIMI, A. J.
Economic and Environmental Issues of the Proposed Extension of the Winter Navigation Season and Improvements on the Great Lakes-St. Lawrence Seaway System,
W83-03072 6G

NISHIDA, H.
Computation of the Index of Pollution Caused by Heavy Metals in River Sediment,
W83-03049 5B

NNAJI, S.
A Study of the Bed-Load Yield From a Watershed,
W83-03096 2J

NOFZIGER, D. L.
Water Management and Salinity Control in Irrigated Swelling and Shrinking Soils,
W83-03038 3F

NORTON, S. A.
Metal Input and Mobilization in Two Acid-Stressed Lake Watersheds in Maine,
W83-02891 5B

NOVAK, J. T.
Coagulation and Removal of Algal Suspensions From Wastewater Stabilization Ponds,
W83-02903 5D

NOVAK, M. D.
Test of an Equation for Evaporation From Bare Soil,
W83-02929 2G

O'CONNOR, J. T.
Coagulation and Removal of Algal Suspensions From Wastewater Stabilization Ponds,
W83-02903 5D

OBERDORFER, J. A.
Wastewater Injection Well Problems, Processes and Standards,
W83-03102 5E

OLDHAM, R. W.
Updip Delineation of the Tertiary Limestone Aquifer, South Carolina,
W83-02896 2F

OLIPHANT, J.
Transport of Water in Frozen Soil: I. Experimental Determination of Soil-Water Diffusivity Under Isothermal Conditions,
W83-03054 2C

OLSON, B. H.
Statewide Evaluation of Trace Element Accumulation From Long Term Disposal of Waste Water,
W83-02892 3C

ONGLEY, E. D.
Data Filtering for Large Area Analysis-An Example From the Canadian Nearshore Zone of the Great Lakes,
W83-03085 7C

OSTERKAMP, W. R.
Streamflow Characteristics Related to Channel Geometry of Streams in Western United States,
W83-02969 2E

OTTMANN, E.
Utilization of Computerized Water Monitoring and Information System,
W83-02883 7A

OVEN-THOMPSON, K.
Agricultural Vs. Hydropower Tradeoffs in the Operation of the High Aswan Dam,
W83-02934 6B

OVERMAN, A. R.
A Kinetic Model of Steady State Phosphorus Fixation in a Batch Reactor--IV,
W83-02952 5D

OWE, M.
Soil Moisture Variation Patterns Observed in Hand County, South Dakota,
W83-03138 2G

OYARZABAL, F.
Laws and Institutions That Regulate Surface Waters in Mexico (Commentarios a Las Leyes e Instituciones Que Reglamentan Las Aguas Superficiales de Mexico),
W83-03004 6E

The Quality of Water of the Rio Bravo Basin (La Calidad De Las Aguas Del Bajo Rio Bravo),
W83-03019 6E

PACKARD, E. M.
Delineation and Hydrologic Effects of a Gasoline Leak at Stovepipe Wells Hotel, Death Valley National Monument, California,
W83-02982 5B

PAGE, G. W.
Maximum Contaminant Levels for Toxic Substances in Water: A Statistical Approach,
W83-03145 5A

PAHWA, S. B.
Numerical Simulation of Flow and Contaminant Migration at an Extensively Monitored Landfill,
W83-02942 5B

PARKER, C. D.
An Integrated Low Cost System for Treatment of Potato Processing Wasterwater Incorporating Anaerobic Fermentation and Phosphorus Removal,
W83-03124 5D

PARKER, J. C
Water Adsorption and Swelling of Clay Minerals in Soil Systems,
W83-02996 2G

PARKER, J. G.
An Integrated Low Cost System for Treatment of Potato Processing Wasterwater Incorporating Anaerobic Fermentation and Phosphorus Removal,
W83-03124 5D

PARKER, J. I.
Sorption and Sedimentation of Zn and Cd by Seston in Southern Lake Michigan,
W83-03083 5B

PARKIN, G. F.
Response of Methane Fermentation Systems to Industrial Toxicants,
W83-02833 5D

PASSINO, R.
Kinetics of Dissimilatory Nitrate and Nitrite Reduction in Suspended Growth Culture,
W83-02806 5D

PATTERSON, G. L.
Hydrologic Characteristics of Surface-Mined Land Reclaimed by Sludge Irrigation, Fulton County, Illinois,
W83-02975 5A

PATTERSON, R. L.
Impact of Power Plant Entrainment of Ichthyoplankton on Juvenile Recruitment of Four Fishes in Western Lake Erie in 1975-77,
W83-03075 5C

PAUL, J. F.
Turbidity in the Western Basin of Lake Erie,
W83-03118 2J

PAYNE, F. G.
Sources of Petroleum Hydrocarbon Inputs to the Marine Environment,
W83-02863 5B

PERKINS, M. A.
Alum Control of Internal Phosphorus Loading in a Shallow Lake,
W83-03140 5G

PERROUX, K. M.
Absorption of Water by Soil: The Effect of a Surface Crust,
W83-02997 2G

PETERS, N. E.
Chemical Composition of Bulk Precipitation in the North-Central and Northeastern United States, December 1980 Through February 1981,
W83-02968 2K

PETERSON, F. L.
Wastewater Injection Well Problems, Processes and Standards,
W83-03102 5E

PEVERLY, J. H.
Prediction of the Response of Pond Biota to Animal Waste Fertilization,
W83-03103 5C

PEYRE, D.
The Measurement of Total Phosphorus in Waste Water (Le Dosage du Phosphore Total Dans Les Eaux Usees),
W83-02816 5A

PFANNKUCH, H. O.
Hydrocarbon Spills, Their Retention in the Subsurface and Propagation into Shallow Aquifers,
W83-02895 5B

PHILLIPS, R. A.
Hydrological and Environmental Controls on Water Management in Semiarid Urban Areas -- Phase II,
W83-02918 4D

PHILLIPS, R. E.
Salt Generation in Pyritic Coal Spoils and its Effect on Saturated Hydraulic Conductivity,
W83-03024 5B

PIETERSE, M. J.
Packaging of Information- Part and Parcel of Successful Technology Transfer,
W83-02859 7C

POLAK, J.
Ultrasonic Telemetry Studies of Fish Activity Near the Nanticoke Thermal Generating Station,
W83-03074 5C

POLTA, R. C.
Evaluation of EPA Un-Ionized Ammonia Toxicity Criteria,
W83-03091 5G

POPPINGHAUS, K.
Water Pollution Control in Developing Areas - Training and Education,
W83-02875 5G

PREND, D. J.
Energy Recovery From the Reject Brine of Reverse Osmosis Systems,
W83-03113 3A

PRIESTLY, A. J.
Water and Wastewater Treatment With Reusable Magnetite Particles,
W83-02852 5D

PRISBREY, K. A.
Computer-Linked CCD Camera for Sediment Shape Analysis,
W83-03111 7B

PUTNAM, H. D.
Evaluation of EPA Un-Ionized Ammonia Toxicity Criteria,
W83-03091 5G

RABENI, C. F.
An Ecological Study of Ozark Streams,
W83-02916 6G

RAE, J.
An in Situ Comparison of the Effectiveness of Four Algicides,
W83-03137 5D

RAKHMANIN, YU. A.
Sanitary Microbiologic Assessment of Water Desalination by Distillation (Sanitarno-Mikrobiologicheskaya Otsenka Distillyatsionnogo Metoda Opresneniya Vody),
W83-03010 3A

RAMADORI, R.
Kinetics of Dissimilatory Nitrate and Nitrite Reduction in Suspended Growth Culture,
W83-02806 5D

RAMSAHOYE, S. I.
Flow Duration Curves in Tropical Equatorial Regions,
W83-03018 2E

RAPINAT, M.
Recent Developments in Water Treatment in France,
W83-03069 5F

RAPPORT, D. J.
Ten Ecosystem Approaches to the Planning and Management of the Great Lakes,
W83-03082 6A

RATKE, R.
Collocation Formulations for the Finite Element Analysis of Tidal and Transport Processes in Estuaries,
W83-03055 2L

RAUSHKOLB, R. S.
Salinity and Boron Control Under High-Frequency Low-Volume Irrigation,
W83-02908 5B

RAWITZ, E.
Calibration and Field Testing of a Two-Probe Gamma Gauge,
W83-02964 7B

READ, A. D.
Legal and Administrative Control Aspects of Oil Pollution,
W83-02868 5G

READ, P. A.
Water Quality Improvement in the Firth or Forth: A Discriminant Functional Analysis,
W83-03059 5G

RECKHOW, K. H.
An Examination of Land Use - Nutrient Export Relationships,
W83-03144 5B

REED, J. E.
Preliminary Projections of the Effects of Chloride-Control Structures on the Quaternary Aquifer at Great Salt Plains, Oklahoma,
W83-02988 5G

REEVES, H. E.
Irrigation Water Management for Wide-Spaced Furrow Irrigation,
W83-03037 3F

REGIER, H. A.
Ten Ecosystem Approaches to the Planning and Management of the Great Lakes,
W83-03082 6A

REIMERS, R. S.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W83-02887 5B

REISSIG, H.
Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Water with the Aid of Incubation Experiments. Part 1: Determination of Rates of Phosphorus and Iron Release (Bestimmung von Nahrstoff- und Metall-Freisetzungsraten aus Sedimenten Umweltbelasteter Fliessgewasserstauhaltungen mit Hilfe von Inkubationsversuchen. Teil 1: Bestimmung von Phosphor- und Eisenfreisetzungsraten),
W83-03053 5B

Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Waters with the aid of Incubation Experiments. Part 2: Investigations on Nitrogen and Manganese Release (Bestimmung Von Nahrstoff- Und Metallfreisetzungsraten Aus Sedimenten Unweltbelasteter Fliessgewasserstau-Haltungen Mit Hilfe Von Inkubationsversuchen. Teil 2: Untersuchungen Zur Stickstoff-Und Manganfreisetzung),
W83-03052 5B

RENSHAW, T.
Water Quality Improvement in the Firth or Forth: A Discriminant Functional Analysis,
W83-03059 5G

RESNICK, S. D.
Hydrological and Environmental Controls on Water Management in Semiarid Urban Areas -- Phase II,
W83-02918 4D

REVFEIM, K. J. A.
Seasonal Patterns in Extreme 1-Hour Rainfalls,
W83-02932 2B

REVIS, N. W.
The Relationship of Minerals Commonly Found in Drinking Water to Atherosclerosis and Hypertension in Pigeons,
W83-03081 5C

REYNOLDS, S. E.
Federal Water Policy and New Mexico Water,
W83-02922 6E

RICH, P. R.
Benefits of Pollution Control on Massachusetts' Housatonic River: A Hedonic Pricing Approach,
W83-03141 6B

RICHARD, Y.
Elements of the Inhibition of Nitrifying Bacteria,
W83-03127 5D

RICHTER, G. A.
Team Effort Solves Operational Problems,
W83-02805 5D

RIGBY, M. G.
Statewide Evaluation of Trace Element Accumulation From Long Term Disposal of Waste Water,
W83-02892 3C

RINCKE, G.
Theme 3: The Economics of Water Pollution Control and Research: Introduction by the Session Convenor,
W83-02869 6B

RINCON VALDES, C. A.
Groundwater Resources in the Juarez-El Paso Region (De Aguas Subterraneas en la Region de Juarez-El Paso),
W83-03020 2F

Surface Water Availability and Future Demand along the Border from Juarez to Matamoros (Disponibilidad de Aguas Superficiales Y su Demanda Futuro a lo Largo De la Franja Fronteriza Desde Ciudad Juarez, Chihuahua, Hasta Matamoros, Tamaulipas),
W83-03022 6E

RINKER, R. E.
Computer-Linked CCD Camera for Sediment Shape Analysis,
W83-03111 7B

RIOJAS, A. H.
Volatilization of Organic Trace Contaminants by Air Stripping for Water Reclamation,
W83-02917 5D

ROBERTS, P. V.
Volatilization of Organic Trace Contaminants by Air Stripping for Water Reclamation,
W83-02917 5D

ROETS, S. D
A System Developed for the Treatment of Tanning and Other Proteinaceous Effluents,
W83-02853 5D

ROGERS, A. N.
Energy Recovery From the Reject Brine of Reverse Osmosis Systems,
W83-03113 3A

ROHLICH, G. A.
Funding Water Pollution Research,
W83-02871 9C

ROHRER, T. K.
Organochlorine and Heavy Metal Residues in Standard Fillets of Coho and Chinook Salmon of the Great Lakes - 1980,
W83-02843 5C

ROLSTON, D. E.
Salinity and Boron Control Under High-Frequency Low-Volume Irrigation,
W83-02908 5B

ROVERI, E.
Reservoir Capacity Conservation (Conservazione Della Capacita Utile Nei Laghi Artificiali),
W83-02953 8A

ROWNTREE, N.
Changes Proposed for Water Management in the United Kingdom,
W83-03065 6E

ROY, D.
Comparative Inactivation of Six Enteroviruses by Ozone,
W83-03068 5F

RUBITSCHUN, C.
Soluble Reactive Phosphorus Measurements in Lake Michigan: Filtration Artifacts,
W83-03084 5A

RUCK, W.
Determination of the Colour of Water and Waste Water (Bestimmung der Farbigkeit Von Wassern),
W83-02819 5A

Elimination of the Chloride Interference in the Determination of the COD (Beseitigung der Chlorid-Storung Bei Der Bestimmung Des CSB),
W83-02814 5A

Investigations on the Elimination Efficiency of Metal Hydroxide Flocs Which are Made Hydrophobic by Precipitation in the Presence of Sodium Stearate (Untersuchungen Uber Die Eliminationswirkung Hydrophobierter Metalloxidhydrat-Flocken),
W83-02812 5D

RUSSELL, C. S.
The National Recreational Fishing Benefits of Water Pollution Control,
W83-03130 6B

RUSSO, D.
Soil Hydraulic Properties as Stochastic Processes: II. Errors of Estimates in a Heterogeneous Field,
W83-02999 2G

RYALS, G. N.
Ground-Water Resources of the Arcadia-Minden Area, Louisiana,
W83-02991 2F

SAMPLES, K. C.
An Economic Analysis of Integrated Fisheries Management: The Case of the Lake Michigan Alewife and Salmonid Fisheries,
W83-02811 6B

SANDBANK, E.
Production of Algal Protein in Raw Sewage,
W83-02856 3C

SANGREY, D. A.
Safety Factors for Probabilistic Slope Design,
W83-03090 8D

SARACEN, W. C.
Characterization and Treatability of the By-Products of Chlorination of Naturally Occurring Humic Substances,
W83-03106 5F

SAVENHED, R.
Modified Stripping Technique for the Analysis of Trace Organics in Water,
W83-03131 5A

SCARPINO, P. V.
The Enumeration of Streptococci and Mycobacteria Present in Landfill Leachate,
W83-02885 5B

The Survival of Bacterial Indicators in Lysimeters and Landfills,
W83-02886 5E

SCHAFER, L.
Small Pump-Turbines to Supplement Grid Capacity,
W83-03006 8C

SCHAUB, S. A.
Microbiological Aerosols From a Field-Source Wastewater Irrigation System,
W83-02835 5B

SCHELSKE, C. L.
Lake-Wide Seasonal Changes in Limnological Conditions in Lake Michigan in 1976,
W83-03079 2H

SCHIEROW, L. J.
An Environmental Quality Index for the Great Lakes,
W83-03148 7C

SCHMOYER, R. L.
The Relationship of Minerals Commonly Found in Drinking Water to Atherosclerosis and Hypertension in Pigeons,
W83-03081 5C

SCHMUGGE, T. J.
Soil Moisture Variation Patterns Observed in Hand County, South Dakota,
W83-03138 2G

SCHNEPPER, D.
Waste From the Water Treatment Plant at Alton and Its Impact on the Mississippi River,
W83-02920 5E

SCHNITZLER, E.
Precaution Measures Against Uplift and Seepage Effects on Gigerwald Arch-Dam (Mesures De Protection Contre Les Effects De La Sous-Pression et Des Infiltrations Au Barrage-Voute De Gigerwald),
W83-02960 8E

SCHRAMM, T.
River and Watercourse Crossings and Lake Outlets With HDPE Pipes (Fluss- und Gewasserkreuzungen Sowie Seeauslaufleitungen Mit Rohren Aus HDPE),
W83-02803 8G

SCHREIBER, J. D.
Organic Carbon and Oxygen Demand Relationships in Stormflow From Southern Pine Watersheds,
W83-03015 5B

SCHUMACHER, P. W.
Microbiological Aerosols From a Field-Source Wastewater Irrigation System,
W83-02835 5B

SCIACCA, S.
Atypical Mycobacteria Isolated at Catania (Microbatteri Atipici Isolati a Catania),
W83-03009 5A

SCRUDATO, R. J.
Lake Ontario Sediment-Mirex Relationships,
W83-02823 5B

SELIDOVKIN, D. A.
Sanitary Microbiologic Assessment of Water Desalination by Distillation (Sanitarno-Mikrobiologicheskaya Otsenka Distillyatsionnogo Metoda Opresneniya Vody),
W83-03010 3A

SHAFFER, G. W.
Wastewater Stabilization Lagoon Effluent Upgrading With Modified Intermittent Sand Filters,
W83-02902 5D

SHAMIR, U.
Optimal Annual Operation of a Water Supply and Distribution System,
W83-03062 6A

SHARMA, K. D.
Sedimentation and its Control in Nadis in the Indian Arid Zone - a Case Study,
W83-03133 2J

SHARMA, P. N.
Optimal Design of Small Reservoir Systems,
W83-02836 3B

SHAROM, M. S.
The Influence of Adsorption on Glass, pH and Temperature on the Disappearance of Permethrin in Aqueous Systems,
W83-03057 5B

SHARPE, W. E.
Nature and Extent of Acid Snowpacks in Pennsylvania,
W83-02943 2C

SHELTON, W. L.
Reproductively Limited Grass Carp for Biological Control of Aquatic Weeds--Broodstock Production and Testing,
W83-02898 4A

SHENG, Y. P.
Wave Action and Bottom Shear Stresses in Lake Erie,
W83-03073 2H

SHEPARD, J. S.
Salt Generation in Pyritic Coal Spoils and its Effect on Saturated Hydraulic Conductivity,
W83-03024 5B

SHIELDS, R. R.
Streamflow Losses to Madison Group Rocks in the Little Belt and Big Snowy Mountains, Montana,
W83-02974 2E

SHILLINGLAW, S. N.
Research Into the Mass Culture of Algae in Closed Systems,
W83-02854 5D

SHOWN, L. M.
Methodology for Hydrologic Evaluation of a Potential Surface Mine: Loblolly Branch Basin, Tuscaloosa County, Alabama,
W83-02976 6G

SIDDOWAY, F. H.
Evaporative Flux From Wheat and Fallow in a Semiarid Climate,
W83-02965 2D

SIDWICK, J. M.
Scale-Up Problems,
W83-02861 5D

SIEDLER, M.
Obtaining an Analytical Grasp of Water Distribution Systems,
W83-03066 5F

SILL, B. L.
A Study of the Bed-Load Yield From a Watershed,
W83-03096 2J

SILVESTON, P. L.
Suppression of Density Waves in Clarifiers,
W83-02880 8B

SIMMONS, D. L.
Process Integration in Sludge Management,
W83-03135 5E

SIMMONS, M. S.
A Saponification Procedure for the Determination of Some Chlorinated Hydrocarbons in Fish,
W83-03077 5A

SIMPSON, J. R.
Water Pollution Control in Developing Areas: Problems and Needs,
W83-02876 5G

SKOGERBOE, G. V.
Defining Cost-Effective Salinity Control Programs,
W83-02829 5G

SLACK, D. C.
Modeling Direct Recharge of Surficial Aquifers,
W83-03101 2F

SMILES, D. E.
Absorption of Water by Soil: The Effect of a Surface Crust,
W83-02997 2G

Hydrodynamic Dispersion During Unsteady, Unsaturated Water Flow in a Clay Soil,
W83-03001 2G

SMITH, J. W.
Team Effort Solves Operational Problems,
W83-02805 5D

SMITH, K. D.
Impact of Power Plant Entrainment of Ichthyoplankton on Juvenile Recruitment of Four Fishes in Western Lake Erie in 1975-77,
W83-03075 5C

SOLOMON, K. R.
The Influence of Adsorption on Glass, pH and Temperature on the Disappearance of Permethrin in Aqueous Systems,
W83-03057 5B

SONZOGNI, W. C.
An Environmental Quality Index for the Great Lakes,
W83-03148 7C

SOO-HOO, R.
Energy Recovery From the Reject Brine of Reverse Osmosis Systems,
W83-03113 3A

SOPHOCLEOUS, M. A.
Water Quality Modeling of the Equus beds Aquifer in South Central Kansas,
W83-03042 5B

SPEECE, R. E.
Response of Methane Fermentation Systems to Industrial Toxicants,
W83-02833 5D

SPINASSE, A.
Sanitary Problems in Relationship With Tap Water Distributed in New or Recent Buildings of Paris (Problems Sanitaires Poses A Paris Par L'Eau Potable Dans Les Immeubles Neufs Ou Recents),
W83-02844 5F

SPOSITO, G.
Trace Metal Complexation by Fulvic Acid Extracted from Sewage Sludge: II. Development of Chemical Models,
W83-03030 5B

STANG, D. L.
Biological and Recreational Aspects of Water Level Management for Clear Lake, Iowa,
W83-03036 6G

STANLAW, K. A.
Sorption and Sedimentation of Zn and Cd by Seston in Southern Lake Michigan,
W83-03083 5B

STEDFAST, D. A.
Flow Model of the Hudson River Estuary From Albany to New Hamburg, New York,
W83-02986 2L

STEDINGER, J. R.
Methods for Deriving Operating Rule Curves for Multiple Reservoir Systems,
W83-03094 4A

STEELE, K. F.
Nutrients and Acid in Rain and Dry Fallout at Fayetteville, Arkansas (1980-1982),
W83-03041 2K

STEINHART, C. E.
An Environmental Quality Index for the Great Lakes,
W83-03148 7C

STENSTROM, M. K.
A Theoretical and Experimental Investigation of the Dynamics of Breakpoint Chlorination in Dispersed Flow Reactors,
W83-02926 5F

STONE, J. F.
Irrigation Water Management for Wide-Spaced Furrow Irrigation,
W83-03037 3F

SUDICKY, E. A.
Contaminant Transport in Fractured Porous Media: Analytical Solutions for a System of Parallel Fractures,
W83-02933 5B

SUMNER, M. E.
Soil Pore Structural Stability and Irrigation Water Quality: I. Empirical Sodium Stability Model,
W83-03027 2G

Soil Pore Structural Stability and Irrigation Water Quality: II. Sodium Stability Data,
W83-03026 2G

Soil Pore Structural Stability and Irrigation Water Quality: III. Evaluation of Soil Stability and Crop Yield in Relation to Salinity and Sodicity,
W83-03025 2G

SUPALLA, R. J.
Is the Ogallala Going Dry.
W83-02839 3F

SUZUKI, S.
Computation of the Index of Pollution Caused by Heavy Metals in River Sediment,
W83-03049 5B

SWEETMAN, J. A.
A Saponification Procedure for the Determination of Some Chlorinated Hydrocarbons in Fish,
W83-03077 5A

SYKES, J. F.
Numerical Simulation of Flow and Contaminant Migration at an Extensively Monitored Landfill,
W83-02942 5B

SZUMSKI, D. S.
Evaluation of EPA Un-Ionized Ammonia Toxicity Criteria,
W83-03091 5G

TABONET, A.
The Measurement of Total Phosphorus in Waste Water (Le Dosage du Phosphore Total Dans Les Eaux Usees),
W83-02816 5A

TADA, F.
Computation of the Index of Pollution Caused by Heavy Metals in River Sediment,
W83-03049 5B

TAKAGI, T.
Stream Function Finite Elements for Nearshore Current,
W83-03064 2L

TANDOI, V.
Kinetics of Dissimilatory Nitrate and Nitrite Reduction in Suspended Growth Culture,
W83-02806 5D

TANG, N. H.
Automation Study of Activated Sludge Processes,
W83-02909 5D

Laboratory Study of Dynamic-State Control of Activated Sludge Processes,
W83-02910 5D

TANJI, K. K.
Salinity Investigations in West Salt Creek, Colorado,
W83-02925 5B

TARAPCHAK, S. J.
Soluble Reactive Phosphorus Measurements in Lake Michigan: Causes of Method-Specific Differences,
W83-02821 5A

Soluble Reactive Phosphorus Measurements in Lake Michigan: Filtration Artifacts,
W83-03084 5A

TASKER, G. D.
Comparing Methods of Hydrologic Regionalization,
W83-03146 7C

Design of Surface-Water Data Networks for Regional Information,
W83-02970 7A

TAYLOR, D. H.
The Effect of Turfgrass Thatch on Water Infiltration Rates,
W83-03023 4A

TELEKI, G. C.
Ultrasonic Telemetry Studies of Fish Activity Near the Nanticoke Thermal Generating Station,
W83-03074 5C

TEOH, C. H.
Evaluation of Rapid Reservoir Storage-Yield Procedures,
W83-03061 4A

THIELK, E. D.
Identification of Total and Biologically Sensitive Forms of Toxic Metal Inputs to an Urban Affected River,
W83-03105 5A

THOMAS, R. P.
Techniques for Estimating Flood Discharges for Unregulated Streams in New Mexico,
W83-02981 2E

THORP, R. F.
Water Requirements for Flooded Rice Cultivation,
W83-03002 3F

TIBBALS, C. H.
Aquifer Test Results, Green Swamp Area, Florida,
W83-02980 2F

TICE, A.
Transport of Water in Frozen Soil: I. Experimental Determination of Soil-Water Diffusivity Under Isothermal Conditions,
W83-03054 2C

TOEBES, G. H.
Management of Existing Reservoir Systems by Interactive Optimization,
W83-02924 6A

TOETZ, D.
Factors Controlling Blue-Green Algae Dominance in a Southwestern Reservoir,
W83-03109 5C

TOLER, L. G.
Hydrologic Characteristics of Surface-Mined Land Reclaimed by Sludge Irrigation, Fulton County, Illinois,
W83-02975 5A

Some Chemical Characteristics of Mine Drainage in Illinois,
W83-02971 5B

TORRIONE, J.
Losses of Water and Underpressures at the Dixence Dam (Pertes D'Eau Et Sous-Pressions Au Barrage De La Grande Dixence),
W83-02962 8F

TORTORICI, L. D.
Thermal Pretreatment of Sludges--A Field Demonstration,
W83-02831 5E

TOWNSEND, R. B.
The Performance of an Ultrafiltration Pilot-Plant for the Closed Loop Recycling of Textile Desizing Effluents,
W83-03123 5D

TRAN, H. G.
A Theoretical and Experimental Investigation of the Dynamics of Breakpoint Chlorination in Dispersed Flow Reactors,
W83-02926 5F

TRIMBLE, S. W.
Soil Conservation in the Coon Creek Basin, Wisconsin,
W83-02827 4D

TROEH, F. R.
Bacterial Utilization of Simple Alcohols and Their Influence on Saturated Hydraulic Conductivity,
W83-03014 2G

TROUT, T. J.
Channel Design to Minimize Lining Material Costs,
W83-02837 8G

TSANG, C. F.
Preliminary Studies of the Reservoir Capacity and the Generating Potential of the Baca Geothermal Field, New Mexico,
W83-02935 2F

TUREKIAN, K. K.
Radium, Thorium and Radioactive Lead Isotopes in Groundwaters: Application to the in Situ Determination of Adsorption-Desorption Rate Constants and Retardation Factors,
W83-02937 2K

TURGEON, A.
Incremental Dynamic Programming May Yield Nonoptimal Solutions,
W83-02941 4A

TURNER, R. M.
Evapotranspiration Before and After Clearing Phreatophytes, Gila River Flood Plain, Graham County, Arizona,
W83-02966 2D

UDEN, P. C.
Characterization and Treatability of the By-Products of Chlorination of Naturally Occurring Humic Substances,
W83-03106 5F

UNNO, H.
Theoretical and Experimental Study of Factors Affecting Capillary Suction Time (CST),
W83-02955 5D

VAN CRAENENBROECK, W.
Application to Rivers and Underground Waters,
W83-02866 5G

VAN DER BEKEN, A.
Application to Rivers and Underground Waters,
W83-02866 5G

VAN STEENDEREN, R. A.
The Role of DOC, UV Absorption and TOH Measurements in Water Pollution Control,
W83-02882 5D

VANDERBROOK, S. G.
Effect of Solution Chemistry on Coagulation with Hydrolyzed Al(III): Significance of Sulfate Ion and pH,
W83-02949 5F

VASCOTTO, G. L.
Changes in Abundance and Growth Characteristics of White Perch From the Mouth of the Bay of Quinte,
W83-02808 6G

VASILENKO, V. E.
Pollution of Ground Waters by Chlorocholine Chloride Used in Agriculture (Voprosy Zagryazneniya Gruntovykh Vod Pri Primenenii Khlorkholinkhlorida V Selyskom Khozyaistve),
W83-03011 5B

VAUCLIN, M.
Spatial Variability of Surface Temperature Along Two Transects of a Bare Soil,
W83-02940 2G

VAUGHAN, W. J.
The National Recreational Fishing Benefits of Water Pollution Control,
W83-03130 6B

VEENSTRA, J. N.
Seasonal Patterns and Molecular Weight Variations of Trihalomethane Precursors and Trihalomethane Forming Potential in the Kaw Reservoir,
W83-03108 5B

VICIDOMINA, F.
Use of EPA's CAPDET Program for Evaluation of Wastewater Treatment Alternatives,
W83-02804 5D

VIEIRA, S. R.
Spatial Variability of Surface Temperature Along Two Transects of a Bare Soil,
W83-02940 2G

VOMOCIL, J. A.
Overland Flow From Sloping Land: Effects of Perched Water Tables and Subsurface Drains,
W83-03028 4A

VONDER HAAR, S.
Preliminary Studies of the Reservoir Capacity and the Generating Potential of the Baca Geothermal Field, New Mexico,
W83-02935 2F

WAGNER, G. H.
Nutrients and Acid in Rain and Dry Fallout at Fayetteville, Arkansas (1980-1982),
W83-03041 2K

WAGNER, J.
Sediment Transport in Alluvial Channels: Rates for Erosion and Deposition of Cohesive Sediments Literature Review and Experimental Design,
W83-03032 2J

WAGNER, R.
Determination of the Colour of Water and Waste Water (Bestimmung der Farbigkeit Von Wassern),
W83-02819 5A

Elimination of the Chloride Interference in the Determination of the COD (Beseitigung der Chlorid-Storung Bei Der Bestimmung Des CSB),
W83-02814 5A

Investigations on the Elimination Efficiency of Metal Hydroxide Flocs Which are Made Hydrophobic by Precipitation in the Presence of Sodium Stearate (Untersuchungen Uber Die Eliminationswirkung Hydrophobierter Metalloxidhydrat-Flocken),
W83-02812 5D

WAHL, K. D.
Hydrology of the Surficial Aquifer in the Floyd River Basin, Iowa,
W83-02993 2F

WALDON, M. G.
Reaeration Rate Estimation Using the Lag in Dissolved Oxygen Concentration,
W83-02914 5A

WALKER, W. R.
Defining Cost-Effective Salinity Control Programs,
W83-02829 5G

WALMSLEY, R. D.
Research Into the Mass Culture of Algae in Closed Systems,
W83-02854 5D

WARD, D. S.
Numerical Simulation of Flow and Contaminant Migration at an Extensively Monitored Landfill,
W83-02942 5B

WARNES, D. D.
A Water Use Comparison Between Corn and Sunflower,
W83-02828 2I

WEBER, J.
Flotation as the Final Clarification Step in Waste-Water Treatment and its Influence on the Oxygen Balance of Receiving Waters,
W83-02848 5D

WEIFFENBACH, C. V.
Radon, Water, and Air Pollution: Risks and Control,
W83-03031 5C

WELBY, C. W.
Use of Geologic and Water Yield Data from Ground Water Based Community Water Systems as a Guide for Ground Water Planning and Management,
W83-03046 4B

WELCH, E. B.
Alum Control of Internal Phosphorus Loading in a Shallow Lake,
W83-03140 5G

WELLS, J. G.
Geologic and Well-Construction Data for the H-7 Borehole Complex Near the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-02977 4B

WESTAWAY, M. T.
Sources of Petroleum Hydrocarbon Inputs to the Marine Environment,
W83-02863 5B

WESTPHAL, J. W.
Assessment of Economic, Social, and Institutional Impacts of Ground-Water Regulation of the Tillman Terrace Aquifer in Southwestern Oklahoma,
W83-03033 4B

WHETSTONE, B. H.
Techniques for Estimating Magnitude and Frequency of Floods in South Carolina,
W83-02979 2E

WHILLANS, T. H.
Changes in Marsh Area Along the Canadian Shore of Lake Ontario,
W83-03076 4C

WHITE, I.
Water Diffusivity of a Field Soil,
W83-02995 2G

WHITTEMORE, D. O.
Variations in Groundwater Quality with Drought,
W83-03044 5B

WHITTIG, L. D.
Salinity Investigations in West Salt Creek, Colorado,
W83-02925 5B

WICKE, H. D.
Effectiveness of Treatment to Meet Phosphorus Objectives in the Great Lakes,
W83-02830 5G

WILLIAMS, J. R.
Water Management and Salinity Control in Irrigated Swelling and Shrinking Soils,
W83-03038 3F

WILLIAMSON, A. K.
Evapotranspiration of Applied Water, Central Valley, California, 1957-78,
W83-02984 2D

WILSON, M. P.
Erosion of Banks Along Piedmont Urban Streams,
W83-02945 2J

WILSON, T. M.
Use of Geologic and Water Yield Data from Ground Water Based Community Water Systems as a Guide for Ground Water Planning and Management,
W83-03046 4B

WILT, M.
Preliminary Studies of the Reservoir Capacity and the Generating Potential of the Baca Geothermal Field, New Mexico,
W83-02935 2F

WINTERS, H.
Microbial Analysis of Domestic Cistern Water in the U. S. Virgin Islands,
W83-03099 5F

Microbial Quality of Water in Old Wells and the Public Water Distribution System in the U. S. Virgin Islands,
W83-03098 5F

WIRRIES, D. L.
Nature and Extent of Acid Snowpacks in Pennsylvania,
W83-02943 2C

WISER, E. H.
Development of a Generalized Hydrologic Modelling System,
W83-02946 2E

WOELL, J. B.
Potential Organometallic Carcinogens in Wastewater Effluents From Coal Gasification Plants,
W83-03110 5B

WOLF, P.
Aerobic Thermophilic Stabilization of Sludge Versus Anaerobic Digestion and Other Kinds of Sludge Treatment at Middle-Sized Plants with Respect to Power Conservation and Economy,
W83-03121 5D

WOLMAN, A.
Clean Water Act - The View From Here,
W83-02832 6E

WOO, H. S.
A Study of the Bed-Load Yield From a Watershed,
W83-03096 2J

WRIGHT, M. W.
The Application of Pretreatment Procedures to Limit Membrane Fouling in Reverse Osmosis Reclamation of Secondary Sewage Effluents,
W83-02849 5D

YADAV, S. S.
Trace Metal Complexation by Fulvic Acid Extracted from Sewage Sludge: II. Development of Chemical Models,
W83-03030 5B

YANG, C. H. J.
Response of Methane Fermentation Systems to Industrial Toxicants,
W83-02833 5D

YOUNG, H. F.
Exposure to Microbial Aerosols From Activated Sludge Treatment,
W83-03097 5D

YOUNG, H. W.
Geothermal Resources in the Banbury Hot Springs Area, Twin Falls County, Idaho,
W83-02972 2F

YURETICH, R. F.
Possible Influences Upon Lake Development in the East African Rift Valleys,
W83-03115 2H

ZELAZNY, L. W.
Water Adsorption and Swelling of Clay Minerals in Soil Systems,
W83-02996 2G

ZEMAN, A. J.
Calcium Carbonate in Postglacial Lake Erie Sediment,
W83-02809 2J

ZUZEL, J. F.
Runoff and Soil Erosion on Frozen Soils in Northeastern Oregon,
W83-02826 2J

ORGANIZATIONAL INDEX

AGENCE DE BASSIN RHONE-MEDITERRANEE-CORSE (FRANCE).
The Measurement of Total Phosphorus in Waste Water (Le Dosage du Phosphore Total Dans Les Eaux Usees),
W83-02816 5A

AGRICULTURAL RESEARCH ORGANIZATION, BET-DAGAN (ISRAEL). DIV. OF SOIL PHYSICS.
Soil Hydraulic Properties as Stochastic Processes: II. Errors of Estimates in a Heterogeneous Field,
W83-02999 2G

Infiltration as Affected by Long-Term Use of Sodic-Saline Water for Irrigation,
W83-03016 3C

AGRICULTURAL RESEARCH SERVICE, KIMBERLY, ID. SNAKE RIVER CONSERVATION RESEARCH CENTER.
Channel Design to Minimize Lining Material Costs,
W83-02837 8G

AGRICULTURAL RESEARCH SERVICE, MORRIS, MN. NORTH CENTRAL SOIL CONSERVATION RESEARCH CENTER.
A Water Use Comparison Between Corn and Sunflower,
W83-02828 2I

AGRICULTURAL RESEARCH SERVICE, OXFORD, MS. SEDIMENTATION LAB.
Organic Carbon and Oxygen Demand Relationships in Stormflow From Southern Pine Watersheds,
W83-03015 5B

AGRICULTURAL RESEARCH SERVICE, PENDLETON, OR. COLUMBIA PLATEAU CONSERVATION RESEARCH CENTER.
Runoff and Soil Erosion on Frozen Soils in Northeastern Oregon,
W83-02826 2J

AGRICULTURAL RESEARCH SERVICE, PROSSER, WA. IRRIGATED AGRICULTURE RESEARCH AND EXTENSION CENTER.
Defining Cost-Effective Salinity Control Programs,
W83-02829 5G

ALABAMA COOPERATIVE FISHERY RESEARCH UNIT, AUBURN.
Reproductively Limited Grass Carp for Biological Control of Aquatic Weeds--Broodstock Production and Testing,
W83-02898 4A

ALASKA UNIV., FAIRBANKS. INST. OF WATER RESOURCES.
Metabolic Properties of Thiobacillus ferrooxidans Isolated from Neutral pH Mine Drainage,
W83-03045 5B

AMERICAN UNIV., WASHINGTON, DC. DEPT. OF CHEMISTRY.
Artifacts and Losses in the Sampling of Chlorinated Waters by XAD Adsorption,
W83-03104 5A

AMERICAN WATER WORKS ASSOCIATION RESEARCH FOUNDATION, DENVER, CO.
Water Recycling Systems,
W83-02878 3D

ARGONNE NATIONAL LAB., IL.
Sorption and Sedimentation of Zn and Cd by Seston in Southern Lake Michigan,
W83-03083 5B

ARIZONA UNIV., TUCSON.
Price, Socioeconomic, and Climatic Influences on Residential Water Use in Southern Arizona,
W83-02894 6D

ARIZONA WATER RESOURCES RESEARCH CENTER, TUCSON.
Hydrological and Environmental Controls on Water Management in Semiarid Urban Areas -- Phase II,
W83-02918 4D

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF GEOLOGY.
Nutrients and Acid in Rain and Dry Fallout at Fayetteville, Arkansas (1980-1982),
W83-03041 2K

ARMY MEDICAL BIOENGINEERING RESEARCH AND DEVELOPMENT LAB., FORT DETRICK, MD.
Microbiological Aerosols From a Field-Source Wastewater Irrigation System,
W83-02835 5B

AUBURN UNIV., AL.
The Influence of Water Exchange On Water Quality and Fish Production in Channel Catfish Ponds,
W83-02905 5G

AUBURN UNIV., AL. DEPT. OF FISHERIES AND ALLIED AQUACULTURES.
Effects of Water Exchange on Water Quality in Channel Catfish Ponds,
W83-02897 5G

AVEIRO UNIV. (PORTUGAL).
Inhibition Modeling In Anaerobic Digestion,
W83-03126 5D

BASF A.G., LUDWIGSHAFEN AM RHEIN (GERMANY, F.R.).
Contents of Metals and Suspended Solids in the Rhine (Metallgehalt und Schwebstoffgehalt im Rhein),
W83-02813 5B

BAYERISCHES LANDESAMT FUER WASSERWIRTSCHAFT, MUNICH (GERMANY, F.R.).
Utilization of Computerized Water Monitoring and Information System,
W83-02883 7A

Aerobic Thermophilic Stabilization of Sludge Versus Anaerobic Digestion and Other Kinds of Sludge Treatment at Middle-Sized Plants with Respect to Power Conservation and Economy,
W83-03121 5D

BECHTEL NATIONAL, INC., SAN FRANCISCO, CA.
Energy Recovery From the Reject Brine of Reverse Osmosis Systems,
W83-03113 3A

BINNIE AND PARTNERS, LONDON (ENGLAND).
Water Requirements for Flooded Rice Cultivation,
W83-03002 3F

BLACK AND VEATCH, DENVER, CO.
Mortality Patterns of Indicator Organisms During Aerobic Digestion,
W83-02834 5E

Water Recycling: Review and Background,
W83-02877 3E

BP INTERNATIONAL LTD., LONDON (ENGLAND).
Sources of Petroleum Hydrocarbon Inputs to the Marine Environment,
W83-02863 5B

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF SOIL SCIENCE.
Test of an Equation for Evaporation From Bare Soil,
W83-02929 2G

BRUSSELS UNIV. (BELGIUM). LAB. OF HYDROLOGY.
Application to Rivers and Underground Waters,
W83-02866 5G

BUNDESVERBAND DER DEUTSCHEN INDUSTRIE E.V., COLOGNE (GERMANY, F.R.).
Guidelines for the Reduction of Wastewater Tax (Hinweise zur Reduzierung Der Abwasserabgabe),
W83-02801 6F

BUREAU D'INGENIEURS-CONSEILS, LAUSANNE (SWITZERLAND).
Precaution Measures Against Uplift and Seepage Effects on Gigerwald Arch-Dam (Mesures De Protection Contre Les Effects De La Sous-Pression et Des Infiltrations Au Barrage-Voute De Gigerwald),
W83-02960 8E

BUREAU OF LAND MANAGEMENT, DENVER, CO. DIV. OF SPECIAL STUDIES.
Runoff and Water Quality From Three Soil Landform Units on Mancos Shale,
W83-03150 2J

CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Preliminary Studies of the Reservoir Capacity and the Generating Potential of the Baca Geothermal Field, New Mexico,
W83-02935 2F

CALIFORNIA UNIV., BERKELEY. SANITARY ENGINEERING RESEARCH LAB.
The Effect of Aeration Basin Configuration on Activated Sludge Bulking at Low Organic Loading,
W83-03120 5D

CALIFORNIA UNIV., DAVIS. DEPT. OF LAND, AIR AND WATER RESOURCES.
Salinity and Boron Control Under High-Frequency Low-Volume Irrigation,
W83-02908 5B

Salinity Investigations in West Salt Creek, Colorado,
W83-02925 5B

Spatial Variability of Surface Temperature Along Two Transects of a Bare Soil,
W83-02940 2G

CALIFORNIA UNIV., DAVIS. DEPT. OF WILDLIFE AND FISHERIES BIOLOGY.
Instream Flow Requirements of Native California Stream Fishes,
W83-02906 6G

Metabolism of California Stream Fishes,
W83-02944 5C

CALIFORNIA UNIV., IRVINE.
Statewide Evaluation of Trace Element Accumulation From Long Term Disposal of Waste Water,
W83-02892 3C

CALIFORNIA UNIV., LOS ANGELES. DEPT. OF GEOGRAPHY.
Soil Conservation in the Coon Creek Basin, Wisconsin,
W83-02827 4D

CALIFORNIA UNIV., LOS ANGELES. SCHOOL OF ENGINEERING AND APPLIED SCIENCE.
A Theoretical and Experimental Investigation of the Dynamics of Breakpoint Chlorination in Dispersed Flow Reactors,
W83-02926 5F

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
Combined Water-Fertilizer Management to Minimize Non-Point Water Pollution While Achieving High Crop Production,
W83-02907 2I

Trace Metal Complexation by Fulvic Acid Extracted from Sewage Sludge: II. Development of Chemical Models,
W83-03030 5B

CALIFORNIA UNIV., SANTA BARBARA. DEPT. OF ECONOMICS.
Water Conservation Kits: A Time Series Analysis of a Conservation Policy,
W83-03136 3D

CALIFORNIA UNIV., SANTA BARBARA. DEPT. OF MECHANICAL AND ENVIRONMENTAL ENGINEERING.
Wave Action and Bottom Shear Stresses in Lake Erie,
W83-03073 2H

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO).
Calcium Carbonate in Postglacial Lake Erie Sediment,
W83-02809 2J

Lake Erie Oxygen Depletion Controversy,
W83-02824 5G

Trends in Lake Ontario Surveillance Parameters, 1974-1980,
W83-02840 2H

Economic and Environmental Issues of the Proposed Extension of the Winter Navigation Season and Improvements on the Great Lakes-St. Lawrence Seaway System,
W83-03072 6G

Data Filtering for Large Area Analysis-An Example From the Canadian Nearshore Zone of the Great Lakes,
W83-03085 7C

CARIBBEAN RESEARCH INST., ST. THOMAS, VI.
Microbial Quality of Water in Old Wells and the Public Water Distribution System in the U. S. Virgin Islands,
W83-03098 5F

Microbial Analysis of Domestic Cistern Water in the U. S. Virgin Islands,
W83-03099 5F

CATANIA UNIV. (ITALY). CATTEDRA DI DERMATOLOGIA PEDIATRICA.
Atypical Mycobacteria Isolated at Catania (Microbatteri Atipici Isolati a Catania),
W83-03009 5A

CENTRAL ARID ZONE RESEARCH INST., JODHPUR (INDIA).
Sedimentation and its Control in Nadis in the Indian Arid Zone - a Case Study,
W83-03133 2J

CH2M HILL SOUTHEAST, INC., GAINESVILLE, FL.
Team Effort Solves Operational Problems,
W83-02805 5D

CHEMICAL INDUSTRY INST. OF TOXICOLOGY, RESEARCH TRIANGLE PARK, NC.
Evaluating Potential Health Risks of Consuming Reused Water,
W83-03086 5C

CHEMVIRON S.A., BRUSSELS (BELGIUM).
Removal of Pesticides and Herbicides by Means of Adsorption on Activated Carbon,
W83-02857 5G

CHUO UNIV., TOKYO (JAPAN). DEPT. OF CIVIL ENGINEERING.
Stream Function Finite Elements for Nearshore Current,
W83-03064 2L

CINCINNATI UNIV., OH. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
The Enumeration of Streptococci and Mycobacteria Present in Landfill Leachate,
W83-02885 5B

The Survival of Bacterial Indicators in Lysimeters and Landfills,
W83-02886 5E

CLEMSON UNIV., SC. DEPT. OF CIVIL ENGINEERING.
A Study of the Bed-Load Yield From a Watershed,
W83-03096 2J

COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
Transport of Water in Frozen Soil: I. Experimental Determination of Soil-Water Diffusivity Under Isothermal Conditions,
W83-03054 2C

Mobilization, Movement and Deposition of Active Subaerial Sediment Flows, Matanuska Glacier, Alaska,
W83-03116 2J

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Solar Heating of Wastewater Stabilization Ponds,
W83-03100 5D

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF ENVIRONMENTAL MECHANICS.
Water Diffusivity of a Field Soil,
W83-02995 2G

Absorption of Water by Soil: The Effect of a Surface Crust,
W83-02997 2G

Hydrodynamic Dispersion During Unsteady, Unsaturated Water Flow in a Clay Soil,
W83-03001 2G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, SOUTH MELBOURNE (AUSTRALIA). DIV. OF CHEMICAL TECHNOLOGY.
Water and Wastewater Treatment With Reusable Magnetite Particles,
W83-02852 5D

Colour and Turbidity Removal With Reusable Magnetite Particles--IV. Alkali Activated Magnetite--A New Solid, Reusable Coagulant-Adsorbent,
W83-02948 5F

COMPAGNIE GENERALE DES EAUX, PARIS (FRANCE).
Water and Air Renewal in Reservoirs (Les Reservoirs D'eau Potable. 1-Le Renouvellement Methodique de L'eau et de L'air Dans les Reservoirs),
W83-02815 5G

Recent Developments in Water Treatment in France,
W83-03069 5F

CONTRAGA, INC., GROEBENZELL (GERMANY, F.R.).
Computer Control in a Biological Sewage Plant, Methods and Experience,
W83-02851 5D

CORNELL UNIV. AGRICULTURAL EXPERIMENT STATION, ITHACA, NY. DEPT. OF AGRONOMY.
Prediction of the Response of Pond Biota to Animal Waste Fertilization,
W83-03103 5C

CORNELL UNIV., ITHACA, NY. CENTER FOR ENVIRONMENTAL RESEARCH.
Methods for Deriving Operating Rule Curves for Multiple Reservoir Systems,
W83-03094 4A

CORNELL UNIV., ITHACA, NY. SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Process Integration in Sludge Management,
W83-03135 5E

DEPARTMENT OF ENERGY, LONDON (ENGLAND). PETROLEUM ENGINEERING DIV.
Legal and Administrative Control Aspects of Oil Pollution,
W83-02868 5G

DEPARTMENT OF WATER AFFAIRS, FORESTRY AND ENVIRONMENTAL CONSERVATION, CAPE TOWN (SOUTH AFRICA).
Funding Water Pollution Control in South Africa,
W83-02870 6F

DREXEL UNIV., PHILADELPHIA, PA. ENVIRONMENTAL STUDIES INST.
Response of Methane Fermentation Systems to Industrial Toxicants,
W83-02833 5D

DUKE UNIV., DURHAM, NC. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Hydrologic and Water Quality Modeling for Instream Flow Strategies,
W83-02927 6C

ECONOMIC RESEARCH SERVICE, WASHINGTON, DC.
Benefits of Pollution Control on Massachusetts' Housatonic River: A Hedonic Pricing Approach,
W83-03141 6B

EIDGENOESSISCHE ANSTALT FUER WASSERVERSORGUNG, ABWASSERREINIGUNG UND GEWAESSERSCHULTZ, DUEBENDORF (SWITZERLAND).
Rate Constants of Reactions of Ozone with Organic and Inorganic Compounds in Water--I. Non-Dissociating Organic Compounds,
W83-02950 5F

Rate Constants of Reactions of Ozone With Organic and Inorganic Compounds in Water--II. Dissociating Organic Compounds,
W83-02951 5F

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH. DRINKING WATER RESEARCH DIV.
The Role of Filtration in Preventing Waterborne Disease,
W83-03088 5F

ENVIRONMENTAL PROTECTION AGENCY, NARRAGANSETT, RI.
Turbidity in the Western Basin of Lake Erie,
W83-03118 2J

ENVIRONMENTAL RESEARCH LAB., ATHENS, GA.
The Use of Water Quality Models in Management Decision Making,
W83-02847 5G

ENVIRONMENTAL RESEARCH LAB.-DULUTH, GROSSE ILE, MI. LARGE LAKES RESEARCH STATION.
Mass Balance Modeling of Heavy Metals in Saginaw Bay, Lake Huron,
W83-02820 5B

ESCUELA SUPERIOR DE AGRICULTURA HERMANOS ESCOBAR, CHIHUAHUA (MEXICO). AREA DE MANEJO DE AGUA Y SUELO.
Groundwater Resources in the Juarez-El Paso Region (De Aguas Subterraneas en la Region de Juarez-El Paso),
W83-03020 2F

Surface Water Availability and Future Demand along the Border from Juarez to Matamoros (Disponibilidad de Aguas Superficiales Y su Demanda Futuro a lo Largo De la Franja Fronteriza Desde Ciudad Juarez, Chihuahua, Hasta Matamoros, Tamaulipas),
W83-03022 6E

EUROPLAST ROHRWERK G.M.B.H., OBERHAUSEN (GERMANY, F.R.). TECHNISCHE BERATUNG UND PROJEKTIERUNG.
River and Watercourse Crossings and Lake Outlets With HDPE Pipes (Fluss- und Gewasserkreuzungen Sowie Seeauslaufleitungen Mit Rohren Aus HDPE),
W83-02803 8G

FENIX AND SCISSON, INC., TULSA, OK.
Geologic and Well-Construction Data for the H-7 Borehole Complex Near the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-02977 4B

FISH AND WILDLIFE SERVICE, SANDUSKY, OH. BIOLOGICAL STATION.
Food of Freshwater Drum in Western Lake Erie,
W83-02810 2H

FLORIDA UNIV., GAINESVILLE. DEPT. OF AGRICULTURAL ENGINEERING.
A Kinetic Model of Steady State Phosphorus Fixation in a Batch Reactor--IV,
W83-02952 5D

FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V., KARLSRUHE (GERMANY, F.R.). INST. FUER INFORMATIONS- UND DATENVERARBEITUNG.
Modern Information Systems for Water Supply Companies-Requirements and Functions (Moderne Informationssysteme Fur Wasserwarten - Anforderungen Und Funktionen),
W83-03058 7A

GEOLOGICAL SURVEY, ALBANY, NY. WATER RESOURCES DIV.
Chemical Composition of Bulk Precipitation in the North-Central and Northeastern United States, December 1980 Through February 1981,
W83-02968 2K

Flow Model of the Hudson River Estuary From Albany to New Hamburg, New York,
W83-02986 2L

GEOLOGICAL SURVEY, ALBUQUERQUE, NM. WATER RESOURCES DIV.
Techniques for Estimating Flood Discharges for Unregulated Streams in New Mexico,
W83-02981 2E

GEOLOGICAL SURVEY, AUGUSTA, ME. WATER RESOURCES DIV.
Floods in Maine, April-May 1979,
W83-02983 2E

GEOLOGICAL SURVEY, BATON ROUGE, LA. WATER RESOURCES DIV.
Ground-Water Resources of the Arcadia-Minden Area, Louisiana,
W83-02991 2F

GEOLOGICAL SURVEY, BOISE, ID. WATER RESOURCES DIV.
Geothermal Resources in the Banbury Hot Springs Area, Twin Falls County, Idaho,
W83-02972 2F

GEOLOGICAL SURVEY, BOSTON, MA. WATER RESOURCES DIV.
Hydrologic Data of the Lake Cochituate Drainage Basin, Framingham-Natick, Massachusetts,
W83-02989 7C

Hydrologic Data of the Lower Merrimack River Basin, Massachusetts, from Concord River, Lowell, to Plum Island, Newburyport,
W83-02994 7C

GEOLOGICAL SURVEY, COLUMBIA, SC. WATER RESOURCES DIV.
Techniques for Estimating Magnitude and Frequency of Floods in South Carolina,
W83-02979 2E

GEOLOGICAL SURVEY, DENVER, CO.
Sources, Sinks, and Storage of River Sediment in the Atlantic Drainage of the United States,
W83-03117 2J

GEOLOGICAL SURVEY, DENVER, CO. WATER RESOURCES DIV.
Methodology for Hydrologic Evaluation of a Potential Surface Mine: Loblolly Branch Basin, Tuscaloosa County, Alabama,
W83-02976 6G

GEOLOGICAL SURVEY, HELENA, MT. WATER RESOURCES DIV.
Streamflow Losses to Madison Group Rocks in the Little Belt and Big Snowy Mountains, Montana,
W83-02974 2E

GEOLOGICAL SURVEY, IOWA CITY, IA. WATER RESOURCES DIV.
Hydrology of the Surficial Aquifer in the Floyd River Basin, Iowa,
W83-02993 2F

GEOLOGICAL SURVEY, ITHACA, NY. WATER RESOURCES DIV.
Geology and Ground-Water Resources of Oswego County, New York,
W83-02987 2F

GEOLOGICAL SURVEY, LAWRENCE, KS. WATER RESOURCES DIV.
Streamflow Characteristics Related to Channel Geometry of Streams in Western United States,
W83-02969 2E

Storage Requirements to Sustain Gross Reservoir Outflow From Small Basins in Kansas,
W83-02992 2E

GEOLOGICAL SURVEY, MADISON, WI. WATER RESOURCES DIV.
Aquatic Biology in Nederlo Creek, Southwestern Wisconsin,
W83-02978 6G

Effects of a Floodwater-Retarding Structure on the Hydrology and Ecology of Trout Creek in Southwestern Wisconsin.
W83-02985 6G

GEOLOGICAL SURVEY, MENLO PARK, CA.
On Lagrangian Residual Currents With Applications in South San Francisco Bay, California,
W83-02928 2L

GEOLOGICAL SURVEY, MENLO PARK, CA. WATER RESOURCES DIV.
Temperature Dependence of Unsaturated Hydraulic Conductivity of Two Soils,
W83-03000 2G

GEOLOGICAL SURVEY, OKLAHOMA CITY, OK. WATER RESOURCES DIV.
Preliminary Projections of the Effects of Chloride-Control Structures on the Quaternary Aquifer at Great Salt Plains, Oklahoma,
W83-02988 5G

GEOLOGICAL SURVEY, RESTON, VA.
Comparing Methods of Hydrologic Regionalization,
W83-03146 7C

GEOLOGICAL SURVEY, RESTON, VA. WATER RESOURCES DIV.
Water-Data Program of the U.S. Geological Survey,
W83-02967 7A

Design of Surface-Water Data Networks for Regional Information,
W83-02970 7A

GEOLOGICAL SURVEY, SACRAMENTO, CA. WATER RESOURCES DIV.
Delineation and Hydrologic Effects of a Gasoline Leak at Stovepipe Wells Hotel, Death Valley National Monument, California,
W83-02982 5B

Evapotranspiration of Applied Water, Central Valley, California, 1957-78,
W83-02984 2D

GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.
Water Resources and Data-Network Assessment of the Manasota Basin, Manatee and Sarasota Counties, Florida,
W83-02973 7A

Aquifer Test Results, Green Swamp Area, Florida,
W83-02980 2F

Estimated Water Use in Florida, 1980,
W83-02990 6D

GEOLOGICAL SURVEY, TUCSON, AZ. WATER RESOURCES DIV.
Evapotranspiration Before and After Clearing Phreatophytes, Gila River Flood Plain, Graham County, Arizona,
W83-02966 2D

GEOLOGICAL SURVEY, URBANA, IL. WATER RESOURCES DIV.
Some Chemical Characteristics of Mine Drainage in Illinois,
W83-02971 5B

Hydrologic Characteristics of Surface-Mined Land Reclaimed by Sludge Irrigation, Fulton County, Illinois,
W83-02975 5A

GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF CIVIL ENGINEERING.
Aquifer Parameter Prediction by Numerical Modeling,
W83-02912 2F

GEORGIA UNIV., ATHENS. DEPT. OF MICROBIOLOGY.
Microbial Degradation of Natural and Pollutionally-Derived Lignocellulosic Detritus in Wetland Ecosystems,
W83-02913 5B

GEORGIA UNIV., ATHENS. SCHOOL OF FOREST RESOURCES.
Stream Temperature Under an Inadequate Buffer Strip in the Southeast Piedmont,
W83-03149 6G

GRAND ISLAND BIOLOGICAL CO., NY.
Comparative Inactivation of Six Enteroviruses by Ozone,
W83-03068 5F

GRANDE DIXENCE SOCIETE ANONYME, SION (SWITZERLAND).
Losses of Water and Underpressures at the Dixence Dam (Pertes D'Eau Et Sous-Pressions Au Barrage De La Grande Dixence),
W83-02962 8F

GUELPH UNIV. (ONTARIO). DEPT. OF ENVIRONMENTAL BIOLOGY.
The Influence of Adsorption on Glass, pH and Temperature on the Disappearance of Permethrin in Aqueous Systems,
W83-03057 5B

GUELPH UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.
Shore Protection in the Town of Stoney Creek, Southwest Lake Ontario, 1934-1979: Historical Changes and Durability of Structures,
W83-02842 4D

HANOVER UNIV. (GERMANY, F.R.).
Collocation Formulations for the Finite Element Analysis of Tidal and Transport Processes in Estuaries,
W83-03055 2L

HAWAII UNIV. AT MANOA, HONOLULU. WATER RESOURCES RESEARCH CENTER.
Wastewater Injection Well Problems, Processes and Standards,
W83-03102 5E

HAWAII UNIV., HONOLULU. DEPT. OF AGRICULTURAL AND RESOURCE ECONOMICS.
An Economic Analysis of Integrated Fisheries Management: The Case of the Lake Michigan Alewife and Salmonid Fisheries,
W83-02811 6B

HAWAII UNIV., HONOLULU. WATER RESOURCES RESEARCH CENTER.
Exposure to Microbial Aerosols From Activated Sludge Treatment,
W83-03097 5D

HAZEN AND SAWYER, MIAMI, FL.
Building Water and Sanitation Projects in Rural Guatemala,
W83-03071 5F

HEALTH EFFECTS RESEARCH LAB., CINCINNATI, OH.
Drinking Water and Legionnaires' Disease,
W83-03067 5F

Toxicological Problems Associated with Alternative Methods of Disinfection,
W83-03087 5C

HEBREW UNIV., REHOVOTH (ISRAEL). DEPT. OF SOIL AND WATER SCIENCES.
Calibration and Field Testing of a Two-Probe Gamma Gauge,
W83-02964 7B

HEIST ENGINEERING CORP., WALNUT CREEK, CA.
Design and Evaluation of an AFVC Wash Column With Direct Melting on the Ice Plug,
W83-03040 3A

HYDRO-QUEBEC, VARENNES.
Incremental Dynamic Programming May Yield Nonoptimal Solutions,
W83-02941 4A

IDAHO UNIV., MOSCOW. COLL. OF MINES AND EARTH RESOURCES.
Computer-Linked CCD Camera for Sediment Shape Analysis,
W83-03111 7B

IDAHO UNIV., MOSCOW. DEPT. OF AGRICULTURAL ECONOMICS.
The Potential Impact of Water Reallocations on Agriculture in Idaho,
W83-03143 6B

IDAHO UNIV., MOSCOW. DEPT. OF AGRICULTURAL ENGINEERING.
Weather and Consumptive Use in the Bear River Basin, Idaho During 1982,
W83-02911 2D

IDAHO UNIV., MOSCOW. DEPT. OF FOREST RESOURCES.
Statistics of Species Abundance Distributions in Monitoring Aquatic Communities,
W83-03035 5C

ILLINOIS STATE WATER SURVEY DIV., CHAMPAIGN.
Waste From the Water Treatment Plant at Alton and Its Impact on the Mississippi River,
W83-02920 5E

Hydrology, Hydraulics, and Sediment Transport, Kankakee and Iroquois Rivers,
W83-02921 2J

INSTITUT NATIONAL DE LA RECHERCHE SCIENTIFIQUE, SAINTE-FOY (QUEBEC).
Toxicity Assessment of Snowmelt Water Runoff in an Urban Area (Toxicite Des Eaux De Ruissellement De La Fonte De Neige En Milieu Urbain),
W83-02958 5C

INSTITUTE OF GENERAL AND MUNICIPAL HYGIENE, MOSCOW (USSR).
Sanitary Microbiologic Assessment of Water Desalination by Distillation (Sanitarno-Mikrobiologicheskaya Otsenka Distillyatsionnogo Metoda Opresneniya Vody),
W83-03010 3A

INTERMEDIATE TECHNOLOGY INDUSTRIAL SERVICES, RUGBY (ENGLAND).
Energy for Rural Development,
W83-03008 8C

IOWA STATE UNIV., AMES. DEPT. OF AGRONOMY.
Stratigraphy and Water Table Relationships of Upland Loess-Derived Soils in South-Central Iowa,
W83-02998 2G

Bacterial Utilization of Simple Alcohols and Their Influence on Saturated Hydraulic Conductivity,
W83-03014 2G

IOWA STATE UNIV., AMES. DEPT. OF ANIMAL ECOLOGY.
Biological and Recreational Aspects of Water Level Management for Clear Lake, Iowa,
W83-03036 6G

IOWA UNIV., IOWA CITY. INST. OF HYDRAULIC RESEARCH.
Toxic Substance Models for the Upper Mississippi and Missouri Rivers,
W83-03114 5B

JOHNS HOPKINS UNIV., BALTIMORE, MD. SCHOOL OF ENGINEERING.
Clean Water Act - The View From Here,
W83-02832 6E

JYVAESKYLAE UNIV. (FINLAND). DEPT. OF BIOLOGY.
Physical and Chemical Properties of Pond Waters Receiving Warm-Water Effluent from a Thermal Power Plant,
W83-02954 5C

KANSAS STATE GEOLOGICAL SURVEY, LAWRENCE.
Application of Linear Systems Theory and Linear Programming to Ground Water Management in Kansas,
W83-03142 4B

KANSAS WATER RESOURCES RESEARCH INST., MANHATTAN.
Water Quality Modeling of the Equus beds Aquifer in South Central Kansas,
W83-03042 5B

Transport Modeling of an Agricultural Pesticide, Phase I,
W83-03043 5B

Variations in Groundwater Quality with Drought,
W83-03044 5B

KARADENIZ TEKNIK UNIV., TRABZON (TURKEY). DEPT. OF CIVIL ENGINEERING.
Time-Dependent, Linearized Two-Dimensional Infiltration and Evaporation from Nonuniform and Nonperiodic Strip Sources,
W83-02938 2G

KARLSRUHE UNIV. (GERMANY, F.R.). INST. FUER HYDROMECHANIK.
Coupling of One- and Two-Dimensional Finite Elements for the Computation of Tidal Flow in Estuaries,
W83-03051 2L

KARLSRUHE UNIV. (GERMANY, F.R.). INST. FUER SIEDLUNGSWASSERWIRTSCHAFT.
Flotation as the Final Clarification Step in Waste-Water Treatment and its Influence on the Oxygen Balance of Receiving Waters,
W83-02848 5D

KENTUCKY AGRICULTURAL EXPERIMENT STATION, LEXINGTON.
Salt Generation in Pyritic Coal Spoils and its Effect on Saturated Hydraulic Conductivity,
W83-03024 5B

KENTUCKY NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET, FRANKFURT. DIV. OF WATER.
An Examination of Land Use - Nutrient Export Relationships,
W83-03144 5B

KERNFORSCHUNGSZENTRUM KARLSRUHE G.M.B.H. (GERMANY, F.R.).
Theme 4: Technology Transfer: Report of the Session Convenor,
W83-02872 5D

KIEV INST. FOR DEVELOPMENTAL MATTERS (USSR).
Hygienic Evaluation of Water Polluted by Pesticides Entering Water Bodies in Surface Runoff (Gigienicheskaya Otsenka Vody, Zagryaznennoi Nekotorymi Pestitsidami Pri Postuplenii Ikh V Vodoem S Poverkhnostnym Stokom),
W83-03017 5C

KOSSLER G.M.B.H., ST. POLTEN-ST. GEORGEN (AUSTRIA).
Installed and Planned Mini Hydro,
W83-03007 8C

LABORATOIRE D'HYGIENE DE LA VILLE DE PARIS (FRANCE).
Sanitary Problems in Relationship With Tap Water Distributed in New or Recent Buildings of Paris (Problems Sanitaires Poses A Paris Par L'Eau Potable Dans Les Immeubles Neufs Ou Recents),
W83-02844 5F

LABORATOIRE DE GLACIOLOGIE ET GEOPHYSIQUE DE L'ENVIRONNEMENT, GRENOBLE (FRANCE).
Chemistry of South Polar Snow,
W83-03119 2K

LINKOEPING UNIV. (SWEDEN). DEPT. OF WATER IN ENVIRONMENT AND SOCIETY.
Modified Stripping Technique for the Analysis of Trace Organics in Water,
W83-03131 5A

LOUISIANA STATE UNIV., BATON ROUGE. INST. FOR ENVIRONMENTAL STUDIES.
Reaeration Rate Estimation Using the Lag in Dissolved Oxygen Concentration,
W83-02914 5A

MAINE UNIV. AT ORONO. DEPT. OF CIVIL ENGINEERING.
Improving Design of a Domestic Waste Disposal System Using an Unsaturated Flow Model and Phosphorus Adsorption,
W83-02900 5D

MAINE UNIV. AT ORONO. DEPT. OF GEOLOGICAL SCIENCES.
Metal Input and Mobilization in Two Acid-Stressed Lake Watersheds in Maine,
W83-02891 5B

MAINE UNIV. AT ORONO. DEPT. OF PHYSICS AND ASTRONOMY.
Radon, Water, and Air Pollution: Risks and Control,
W83-03031 5C

MANHATTAN COLL., BRONX, NY.
Lake-Wide Seasonal Changes in Limnological Conditions in Lake Michigan in 1976,
W83-03079 2H

MANITOBA UNIV., WINNIPEG. DEPT. OF FOOD SCIENCE.
The Exhaustive Reuse of Water in Food Processing,
W83-02884 3E

MANNESMANN-FORSCHUNGSINSTITUT G.M.B.H., DUISBURG (GERMANY, F.R.).
Corrosion Behavior of Passivatable Stainless Steel Under Reducing Conditions with Simultaneous Abrasive Stress (Das Korrosionsverhalten Passivierbarer Nichtrostender Stahle in Wassern Unter Reduzierenden Bedingungen Bei Gleichzeitiger Abrasiver Beanspruchung),
W83-03047 8G

MARYLAND UNIV., COLLEGE PARK. DEPT. OF CHEMISTRY.
EDTA as a Kinetic Inhibitor of Copper(II) Sulfide Precipitation,
W83-02956 5B

MASSACHUSETTS UNIV., AMHERST. DEPT. OF GEOLOGY AND GEOGRAPHY.
Possible Influences Upon Lake Development in the East African Rift Valleys,
W83-03115 2H

MASSACHUSETTS UNIV., AMHERST. WATER RESOURCES RESEARCH CENTER.
Characterization and Treatability of the By-Products of Chlorination of Naturally Occurring Humic Substances,
W83-03106 5F

Effect of Ozonation on the Biodegradability and Adsorbability of Specific Organics to be Removed in the 'Biologically Activated Carbon (BAC)' Process,
W83-03107 5D

MCGRAW-EDISON CO., MOUNTAINSIDE, NJ.
Small Pump-Turbines to Supplement Grid Capacity,
W83-03006 8C

MEKOROTH WATER CO., HAIFA (ISRAEL).
Optimal Annual Operation of a Water Supply and Distribution System,
W83-03062 6A

METCALF AND EDDY, INC., BOSTON, MA.
Agricultural Vs. Hydropower Tradeoffs in the Operation of the High Aswan Dam,
W83-02934 6B

METEOROLOGICAL SERVICE, WELLINGTON (NEW ZEALAND).
Seasonal Patterns in Extreme 1-Hour Rainfalls,
W83-02932 2B

MICHIGAN AGRICULTURAL EXPERIMENT STATION, EAST LANSING.
Midseason Soil Water Recharge for Corn in the Northwestern Corn Belt,
W83-02890 2G

MICHIGAN DEPT. OF NATURAL RESOURCES, LANSING. OFFICE OF TOXIC MATERIALS CONTROL.
Organochlorine and Heavy Metal Residues in Standard Fillets of Coho and Chinook Salmon of the Great Lakes - 1980,
W83-02843 5C

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ENVIRONMENTAL AND INDUSTRIAL HEALTH.
A Saponification Procedure for the Determination of Some Chlorinated Hydrocarbons in Fish,
W83-03077 5A

MICHIGAN UNIV., ANN ARBOR. SCHOOL OF NATURAL RESOURCES.
Impact of Power Plant Entrainment of Ichthyoplankton on Juvenile Recruitment of Four Fishes in Western Lake Erie in 1975-77,
W83-03075 5C

MINNESOTA UNIV., ST. PAUL. DEPT. OF AGRICULTURAL ENGINEERING.
Modeling Direct Recharge of Surficial Aquifers,
W83-03101 2F

MINNESOTA UNIV., ST. PAUL. DEPT. OF GEOLOGY AND GEOPHYSICS.
Hydrocarbon Spills, Their Retention in the Subsurface and Propagation into Shallow Aquifers,
W83-02895 5B

MINNESOTA UNIV., ST. PAUL. DEPT. OF HORTICULTURAL SCIENCE AND LANDSCAPE ARCHITECTURE.
The Effect of Turfgrass Thatch on Water Infiltration Rates,
W83-03023 4A

MINNESOTA UNIV., ST. PAUL. DEPT. OF SOIL SCIENCE.
An Experimental Investigation of Evapotranspiration Estimation Methods,
W83-03034 2D

MISSOURI UNIV.-COLUMBIA. DEPT. OF CHEMISTRY.
A Simplified Scheme for the Analysis of Pollutants in Groundwater and Leachates Contaminated by Hazardous Chemicals,
W83-02904 5A

MISSOURI UNIV.-COLUMBIA. DEPT. OF CIVIL ENGINEERING.
Coagulation and Removal of Algal Suspensions From Wastewater Stabilization Ponds,
W83-02903 5D

MISSOURI UNIV.-COLUMBIA. SCHOOL OF FORESTRY, FISHERIES AND WILDLIFE.
An Ecological Study of Ozark Streams,
W83-02916 6G

MISSOURI UNIV.-ROLLA. DEPT. OF CIVIL ENGINEERING.
Wastewater Stabilization Lagoon Effluent Upgrading With Modified Intermittent Sand Filters,
W83-02902 5D

MONTANA AGRICULTURAL EXPERIMENT STATION, BOZEMAN.
Evaporative Flux From Wheat and Fallow in a Semiarid Climate,
W83-02965 2D

MOSKOVSKII GOSUDARSTVENNYI MEDITSINSKII INST. (I) (USSR).
Pollution of Ground Waters by Chlorocholine Chloride Used in Agriculture (Voprosy Zagryazneniya Gruntovykh Vod Pri Primenenii Khlorkholinkhlorida V Selyskom Khozyaistve),
W83-03011 5B

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH.
A Model of Costs for Treating Drinking Water,
W83-03089 5F

NAPIER COLL. OF COMMERCE AND TECHNOLOGY, EDINBURGH (SCOTLAND).
Water Quality Improvement in the Firth or Forth: A Discriminant Functional Analysis,
W83-03059 5G

NATAL UNIV., DURBAN (SOUTH AFRICA).
The Performance of an Ultrafiltration Pilot-Plant for the Closed Loop Recycling of Textile Desizing Effluents,
W83-03123 5D

NATAL UNIV., PIETERMARITZBURG (SOUTH AFRICA). DEPT. OF SOIL SCIENCE AND AGROMETEOROLOGY.
Soil Pore Structural Stability and Irrigation Water Quality: III. Evaluation of Soil Stability and Crop Yield in Relation to Salinity and Sodicity,
W83-03025 2G

Soil Pore Structural Stability and Irrigation Water Quality: II. Sodium Stability Data,
W83-03026 2G

Soil Pore Structural Stability and Irrigation Water Quality: I. Empirical Sodium Stability Model,
W83-03027 2G

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, GREENBELT, MD. GODDARD SPACE FLIGHT CENTER.
Soil Moisture Variation Patterns Observed in Hand County, South Dakota,
W83-03138 2G

NATIONAL INST. FOR WATER RESEARCH, BELLVILLE (SOUTH AFRICA). CAPE REGIONAL LAB.
The Application of Pretreatment Procedures to Limit Membrane Fouling in Reverse Osmosis Reclamation of Secondary Sewage Effluents,
W83-02849 5D

NATIONAL INST. FOR WATER RESEARCH, CONGELLA (SOUTH AFRICA). NATAL REGIONAL LAB.
The Impact of Diffuse Atmospheric Nutrient Loading on an Oligotrophic Freshwater Lake in a Developing Urban and Industrial Area (Richards Bay, South Africa),
W83-02850 5C

NATIONAL INST. FOR WATER RESEARCH, PRETORIA (SOUTH AFRICA).
Production of Algal Protein in Raw Sewage,
W83-02856 3C

Low-Cost Technology for Water Pollution Control in Developing Countries,
W83-02858 5D

The Use of Mathematical Models in the Formulation of Pollution Control Policies - An Overview,
W83-02864 5

NATIONAL INST. FOR WATER RESEARCH, PRETORIA (SOUTH AFRICA).

The Role of DOC, UV Absorption and TOH Measurements in Water Pollution Control,
W83-02882 5D

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.

Soluble Reactive Phosphorus Measurements in Lake Michigan: Causes of Method-Specific Differences,
W83-02821 5A

Soluble Reactive Phosphorus Measurements in Lake Michigan: Filtration Artifacts,
W83-03084 5A

NATIONAL RESEARCH INST. FOR OCEANOLOGY, STELLENBOSCH (SOUTH AFRICA).

A Chemical Investigation of a Marine Sewage Outfall,
W83-02888 5B

Nutrient-Salinity Relationships in Four Estuaries of the Cape Province, South Africa,
W83-02889 5B

NATIONAL SWEDISH ENVIRONMENT PROTECTION BOARD, SOLNA.

Legal and Administrative Aspects,
W83-02874 5G

NEBRASKA UNIV.-LINCOLN. DEPT. OF AGRICULTURAL ECONOMICS.

Is the Ogallala Going Dry.
W83-02839 3F

NEVADA UNIV. SYSTEM, LAS VEGAS. DESERT RESEARCH INST.

Turbulent Vertical Momentum Transfer in Stratified Environments,
W83-02901 2E

NEVADA UNIV. SYSTEM, RENO. DESERT RESEARCH INST.

Application of Numerical Simulation Techniques to Floodplain Management,
W83-02893 2E

NEWCASTLE UPON TYNE UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.

Mathematical Modelling of Estuaries and Coastal Waters,
W83-02867 2L

NIERSVERBAND, VIERSEN (GERMANY, F.R.).

Simultaneous Pasteurization - Digestion (SPD-Process),
W83-03125 5D

NIPPON INST. OF TECH., SAITAMA. APPLIED STATISTICS LAB.

Computation of the Index of Pollution Caused by Heavy Metals in River Sediment,
W83-03049 5B

NORMANDALE COMMUNITY COLL., BLOOMINGTON, MN.

Vertical Distribution of Profundal Benthos in Lake Superior Sediments,
W83-02822 2H

Retention of Benthic Invertebrates With Different Sieving Techniques,
W83-02825 2H

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING.

Development of a Generalized Hydrologic Modelling System,
W83-02946 2E

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF MARINE, EARTH AND ATMOSPHERIC SCIENCES.

Use of Geologic and Water Yield Data from Ground Water Based Community Water Systems as a Guide for Ground Water Planning and Management,
W83-03046 4B

NORTH CAROLINA UNIV. AT CHARLOTTE. DEPT. OF GEOGRAPHY AND EARTH SCIENCES.

Erosion of Banks Along Piedmont Urban Streams,
W83-02945 2J

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF CHEMISTRY.

Potential Organometallic Carcinogens in Wastewater Effluents From Coal Gasification Plants,
W83-03110 5B

O.H. MATERIALS CO., FINDLAY, OH.

The Influence of Sex, Size, and Season on Mirex Levels Within Selected Tissues of Lake Ontario Salmon,
W83-02841 5C

OAK RIDGE RESEARCH INST., TN.

The Relationship of Minerals Commonly Found in Drinking Water to Atherosclerosis and Hypertension in Pigeons,
W83-03081 5C

OHIO STATE UNIV., COLUMBUS. CENTER FOR LAKE ERIE AREA RESEARCH.

Large Lakes of the World,
W83-03078 2H

OHIO WESLEYAN UNIV., DELAWARE. DEPT. OF GEOGRAPHY AND GEOLOGY.

The Impact of Energy Development in the Tongue River Basin, Southeastern Montana,
W83-03139 4C

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRONOMY.

Irrigation Water Management for Wide-Spaced Furrow Irrigation,
W83-03037 3F

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF CHEMICAL ENGINEERING.

Sediment Transport in Alluvial Channels: Rates for Erosion and Deposition of Cohesive Sediments Literature Review and Experimental Design,
W83-03032 2J

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF GEOLOGY.

Assessment of Economic, Social, and Institutional Impacts of Ground-Water Regulation of the Tillman Terrace Aquifer in Southwestern Oklahoma,
W83-03033 4B

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF ZOOLOGY.

Factors Controlling Blue-Green Algae Dominance in a Southwestern Reservoir,
W83-03109 5C

OKLAHOMA STATE UNIV., STILLWATER. RESEARCH FOUNDATION ELECTRONICS LAB.

Water Management and Salinity Control in Irrigated Swelling and Shrinking Soils,
W83-03038 3F

OKLAHOMA STATE UNIV., STILLWATER. SCHOOL OF CIVIL ENGINEERING.

Seasonal Patterns and Molecular Weight Variations of Trihalomethane Precursors and Trihalomethane Forming Potential in the Kaw Reservoir,
W83-03108 5B

The Effects of pH and Redox Potential on the Release of Heavy Metals From Arkansas River Sediments,
W83-03112 5B

OLIN CHEMICAL GROUP, CHARLESTON, TN.

Mechanism of Clarification Failure,
W83-02807 5D

ONTARIO HYDRO, TORONTO. RESEARCH DIV.

Changes in Abundance and Growth Characteristics of White Perch From the Mouth of the Bay of Quinte,
W83-02808 6G

ONTARIO MINISTRY OF NATURAL RESOURCES, PORT DOVER.

Ultrasonic Telemetry Studies of Fish Activity Near the Nanticoke Thermal Generating Station,
W83-03074 5C

ONTARIO MINISTRY OF THE ENVIRONMENT, REXDALE. LIMNOLOGY AND TOXICITY SECTION.

A Ten-year Study of Phytoplankton Biomass and Composition in the Nanticoke Region of Long Point Bay, Lake Erie,
W83-03080 2H

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). INST. OF ENVIRONMENTAL SCIENCES.

Research Into the Mass Culture of Algae in Closed Systems,
W83-02854 5D

OREGON STATE UNIV., CORVALLIS. AGRICULTURAL EXPERIMENT STATION.

Overland Flow From Sloping Land: Effects of Perched Water Tables and Subsurface Drains,
W83-03028 4A

OTT WATER ENGINEERS, INC., ANCHORAGE, AK.

An in Situ Comparison of the Effectiveness of Four Algicides,
W83-03137 5D

PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION, ARCATA, CA.

Effects of Aggradation and Degradation on Riffle-Pool Morphology in Natural Gravel Channels, Northwestern California,
W83-02936 2J

PARMA UNIV. (ITALY).

Reservoir Capacity Conservation (Conservazione Della Capacita Utile Nei Laghi Artificiali),
W83-02953 8A

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.

Nature and Extent of Acid Snowpacks in Pennsylvania,
W83-02943 2C

PITOMETER ASSOCIATES, COLUMBIA, MD.

Obtaining an Analytical Grasp of Water Distribution Systems,
W83-03066 5F

POLISH ACADEMY OF SCIENCES, ZABRZE. INST. OF ENVIRONMENTAL ENGINEERING.

Nitrification Process in a Packed Bed Reactor With a Chemically Active Bed,
W83-02947 5D

PRINCETON UNIV., NJ. DEPT. OF CIVIL ENGINEERING.

Derivation of Vertically Averaged Equations Describing Multiphase Flow in Porous Media,
W83-02930 2F

A Modeling Approach for Storm Water Quantity and Quality Control Via Detention Basins,
W83-03147 5G

PROCTER AND GAMBLE CO., CINCINNATI, OH.
The Measurement of Complexation Capacity and Conditional Stability Constants for Ligands in Natural Waters,
W83-02957 5A

PUERTO RICO UNIV., MAYAGUEZ. DEPT. OF CIVIL ENGINEERING.
Automation Study of Activated Sludge Processes,
W83-02909 5D

Laboratory Study of Dynamic-State Control of Activated Sludge Processes,
W83-02910 5D

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRONOMY.
A Numerical Study of Raindrop Impact Phenomena: The Rigid Case,
W83-03029 2J

Proofs of the Volume Averaging Theorems for Multiphase Flow,
W83-03063 8B

PURDUE UNIV., LAFAYETTE, IN. WATER RESOURCES RESEARCH CENTER.
Management of Existing Reservoir Systems by Interactive Optimization,
W83-02924 6A

RENNES-1 UNIV. (FRANCE). LAB. OF THE CHEMISTRY OF WATER AND THE ENVIRONMENT.
Elements of the Inhibition of Nitrifying Bacteria,
W83-03127 5D

RESOURCES FOR THE FUTURE, INC., WASHINGTON, DC.
The National Recreational Fishing Benefits of Water Pollution Control,
W83-03130 6B

ROME UNIV. (ITALY). DEPT. OF CHEMICAL ENGINEERING.
Kinetics of Dissimilatory Nitrate and Nitrite Reduction in Suspended Growth Culture,
W83-02806 5D

RUHRVERBAND, ESSEN (GERMANY, F.R.).
Water Recycling - Industrial Applications,
W83-02879 3E

SENATE, WASHINGTON, DC.
The Legislative Reality of a National Water Policy,
W83-02923 6E

SHAWINIGAN ENGINEERING CO. LTD., MONTREAL (QUEBEC).
Flow Duration Curves in Tropical Equatorial Regions,
W83-03018 2E

SHAWINIGAN ENGINEERING CO. LTD., MONTREAL (QUEBEC). HYDRO-ELECTRIC DIV.
Development Potential for Low-Head Hydro,
W83-03005 8C

SILVERTON TANNERY LTD. (SOUTH AFRICA).
A System Developed for the Treatment of Tanning and Other Proteinaceous Effluents,
W83-02853 5D

SOCIETE DEGREMONT, RUEIL-MALMAISON (FRANCE).
Physical-Chemical Methods of Treatment for Oil-Containing Effluents,
W83-02855 5D

SOCIETE FRANCAISE DE DISTRIBUTION D'EAU (FRANCE).
Telecontrol and the Computer in Water Supply (Telesurveillance Et Ordinateur Au Service Des Eaux),
W83-02846 5F

SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF GEOLOGY.
Updip Delineation of the Tertiary Limestone Aquifer, South Carolina,
W83-02896 2F

STANFORD UNIV., CA. DEPT. OF CIVIL ENGINEERING.
Volatilization of Organic Trace Contaminants by Air Stripping for Water Reclamation,
W83-02917 5D

STATE UNIV. OF NEW YORK AT BUFFALO. DEPT. OF CIVIL ENGINEERING.
Contemporary Stochastic Approach to Water Resource Systems: The ARMP and Feature Prediction Models,
W83-03060 2A

STATE UNIV. OF NEW YORK COLL. AT OSWEGO.
Lake Ontario Sediment-Mirex Relationships,
W83-02823 5B

STATE UNIV. OF NEW YORK, SYRACUSE. COLL. OF ENVIRONMENTAL SCIENCE AND FORESTRY.
Effect of Atmospheric Sulfur Pollutants Derived from Acid Precipitation on the Benthic Dynamics of Lakes,
W83-03093 5C

STEWARD, SVIRIDOV AND OLIVER, JOHANNESBURG (SOUTH AFRICA).
Mineralization Problems in the PWV Complex - The Identification of Viable Solutions by Means of a Suite of Mathematical Models,
W83-02881 5G

STUTTGART UNIV. (GERMANY, F.R.). INST. FUER SIEDLUNGSWASSERBAU, WASSERGUETE- UND ABFALLWIRTSCHAFT.
Investigations on the Elimination Efficiency of Metal Hydroxide Flocs Which are Made Hydrophobic by Precipitation in the Presence of Sodium Stearate (Untersuchungen Uber Die Eliminationswirkung Hydrophobierter Metalloxidhydrat-Flocken),
W83-02812 5D

Elimination of the Chloride Interference in the Determination of the COD (Beseitigung der Chlorid-Storung Bei Der Bestimmung Des CSB),
W83-02814 5A

Determination of the Colour of Water and Waste Water (Bestimmung der Farbigkeit Von Wassern),
W83-02819 5A

SYRACUSE UNIV., NY. DEPT. OF CIVIL ENGINEERING.
Effect of Solution Chemistry on Coagulation with Hydrolyzed Al(III): Significance of Sulfate Ion and pH,
W83-02949 5F

SZUMSKI (DAN) AND ASSOCIATES, WALNUT CREEK, CA.
Evaluation of EPA Un-Ionized Ammonia Toxicity Criteria,
W83-03091 5G

TECHNISCHE HOCHSCHULE, AACHEN (GERMANY, F.R.). INST. FUER WASSERBAU.
Water Pollution Control in Developing Areas - Training and Education,
W83-02875 5G

TECHNISCHE HOCHSCHULE, DARMSTADT (GERMANY, F.R.). INST. FUER WASSERVERSORGUNG, ABWASSERBESEITIGUNG UND RAUMPLANUNG.
Theme 3: The Economics of Water Pollution Control and Research: Introduction by the Session Convenor,
W83-02869 6B

TECHNISCHE UNIV., DRESDEN (GERMAN D.R.). BEREICH HYDROBIOLOGIE.
Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Waters with the aid of Incubation Experiments. Part 2: Investigations on Nitrogen and Manganese Release (Bestimmung Von Nahrstoff- Und Metallfreisetzungsraten Aus Sedimenten Unweltbelasteter Fliessgewasserstau-Haltungen Mit Hilfe Von Inkubationsversuchen. Teil 2: Untersuchungen Zur Stickstoff-Und Manganfreisetzung),
W83-03052 5B

Determination of Nutrient and Metal Release Rates in Sediments from Environmentally Polluted Impoundments of Running Water with the Aid of Incubation Experiments. Part 1: Determination of Rates of Phosphorus and Iron Release (Bestimmung von Nahrstoff- und Metall-Freisetzungsraten aus Sedimenten Umweltbelasteter Fliessgewasserstauhaltungen mit Hilfe von Inkubationsversuchen. Teil 1: Bestimmung von Phosphor- und Eisenfreisetzungsraten),
W83-03053 5B

TECHNISCHE UNIV., MUNICH (GERMANY, F.R.). INST. FUER WASSERCHEMIE UND CHEMISCHE BALNEOLOGIE.
Metal Ion Complexation by Aquatic Humus. III. Model Development and Relation to Surface Water. (Komplexierung Von Metallionen Durch Gewasserhuminstoffe. III. Modellentwicklung und Gewasserbezug),
W83-02818 5B

TENNESSEE UNIV., KNOXVILLE. GRADUATE SCHOOL OF PLANNING.
Problems, Issues, Constraints, and Barriers to Water Quality Planning and Management in Urban and Urbanizing Areas (SMSA's) in Tennessee,
W83-02899 6B

TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF CIVIL ENGINEERING.
Effectiveness of Treatment to Meet Phosphorus Objectives in the Great Lakes,
W83-02830 5G

TEXAS UNIV. AT AUSTIN. DEPT. OF CIVIL ENGINEERING.
Funding Water Pollution Research,
W83-02871 9C

TEXAS UNIV. AT DALLAS, RICHARDSON. GRADUATE PROGRAM IN ENVIRONMENTAL SCIENCES.
Granular Activated Carbon and Preozonated Granular Activated Carbon Treatment for Biologically and Physically-Chemically Treated Wastewater Effluents,
W83-03128 5D

THESSALONIKI UNIV., SALONIKA (GREECE). DEPT. OF HYDRAULICS.
Well Recharge in Idealized Rectangular Aquifers,
W83-03056 4B

TOHOKU UNIV., SENDAI (JAPAN). DEPT. OF MECHANICAL ENGINEERING.
Opening of a Fault and Resulting Slip Due to Injection of Fluid for the Extraction of Geothermal Heat,
W83-03132 4B

TOKYO INST. OF TECH. (JAPAN). DEPT. OF ENVIRONMENTAL CHEMISTRY AND ENGINEERING.
Theoretical and Experimental Study of Factors Affecting Capillary Suction Time (CST),
W83-02955 5D

TORONTO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Theme 5: Water Pollution Control in Developing Countries: Report of the Session Convenor,
W83-02873 6F

TORONTO UNIV. (ONTARIO). INST. FOR ENVIRONMENTAL STUDIES.
Changes in Marsh Area Along the Canadian Shore of Lake Ontario,
W83-03076 4C

Ten Ecosystem Approaches to the Planning and Management of the Great Lakes,
W83-03082 6A

TRAVAUX SOUS-MARINS, PENEY (SWITZERLAND).
Dam and River Sand-Drifting Inspection (La Bathymetrie--Technique De Surveillance De L'Ensablement Des Fleuves Et Des Retenues),
W83-02961 2J

TULANE UNIV., NEW ORLEANS, LA. DEPT. OF CIVIL ENGINEERING.
Use of EPA's CAPDET Program for Evaluation of Wastewater Treatment Alternatives,
W83-02804 5D

TULANE UNIV., NEW ORLEANS, LA. SCHOOL OF PUBLIC HEALTH AND TROPICAL MEDICINE.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W83-02887 5B

UNIVERSITY COLL., LONDON (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Fast-Water Streams Deflected by Transverse Walls,
W83-03003 8B

UNIVERSITY COLL. OF WALES, ABERYSTWYTH. DEPT. OF GEOGRAPHY.
Transport of Heavy Metals on Suspended Sediments Under High Flow Conditions in a Mineralized Region of Wales,
W83-03048 5B

VANDERBILT UNIV., NASHVILLE, TN.
The Role of Consultants,
W83-02860 5D

VICTORIA STATE RIVERS AND WATER SUPPLY COMMISSION, ARMADALE (AUSTRALIA).
Evaluation of Rapid Reservoir Storage-Yield Procedures,
W83-03061 4A

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF AGRONOMY.
Water Adsorption and Swelling of Clay Minerals in Soil Systems,
W83-02996 2G

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.
On Subsurface Stormflow: Predictions with Simple Kinematic Theory for Saturated and Unsaturated Flows,
W83-02931 2G

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF AGRICULTURAL ENGINEERING.
Effects of Farming Practices on Sediment in Irrigation Return Flow,
W83-03039 4D

WASHINGTON UNIV., SEATTLE. DEPT. OF CIVIL ENGINEERING.
Alum Control of Internal Phosphorus Loading in a Shallow Lake,
W83-03140 5G

WASHINGTON UNIV., SEATTLE. DEPT. OF GEOLOGICAL SCIENCES.
Settling Velocity of Natural Particles,
W83-02939 2J

WASHINGTON UNIV., SEATTLE. FISHERIES RESEARCH INST.
Identification of Total and Biologically Sensitive Forms of Toxic Metal Inputs to an Urban Affected River,
W83-03105 5A

WATER RESEARCH CENTRE, STEVENAGE (ENGLAND).
Application to Estuarine and Coastal Waters,
W83-02865 5B

WATER RESEARCH COMMISSION, PRETORIA (SOUTH AFRICA).
Packaging of Information- Part and Parcel of Successful Technology Transfer,
W83-02859 7C

WATER SCIENCE LABS. PTY LTD., MELBOURNE (AUSTRALIA).
An Integrated Low Cost System for Treatment of Potato Processing Wasterwater Incorporating Anaerobic Fermentation and Phosphorus Removal,
W83-03124 5D

WATERLOO UNIV. (ONTARIO). DEPT. OF CHEMICAL ENGINEERING.
Suppression of Density Waves in Clarifiers,
W83-02880 8B

WATERLOO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Numerical Simulation of Flow and Contaminant Migration at an Extensively Monitored Landfill,
W83-02942 5B

WATERLOO UNIV. (ONTARIO). DEPT. OF EARTH SCIENCES.
Contaminant Transport in Fractured Porous Media: Analytical Solutions for a System of Parallel Fractures,
W83-02933 5B

WATSON HAWKSLEY, LONDON (ENGLAND).
Scale-Up Problems,
W83-02861 5D

WHIRLPOOL CORP., BENTON HARBOR, MI.
Leaching Characteristics of Industrial Metal Finishing Wastewater Treatment Plant Solids,
W83-03122 5E

WISCONSIN UNIV.-MADISON. DEPT. OF SOIL SCIENCE.
Pollution Potential Ranking of Barnyards for Priority Watershed Planning,
W83-02915 5G

WISCONSIN UNIV.-MADISON. WATER RESOURCES CENTER.
An Environmental Quality Index for the Great Lakes,
W83-03148 7C

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF URBAN PLANNING.
Maximum Contaminant Levels for Toxic Substances in Water: A Statistical Approach,
W83-03145 5A

WORCESTER POLYTECHNIC INST., MA.
Safety Factors for Probabilistic Slope Design,
W83-03090 8D

YALE UNIV., NEW HAVEN, CT. DEPT. OF GEOLOGY AND GEOPHYSICS.
Radium, Thorium and Radioactive Lead Isotopes in Groundwaters: Application to the in Situ Determination of Adsorption-Desorption Rate Constants and Retardation Factors,
W83-02937 2K

ZWECKVERBAND LANDESWASSERVERSORGUNG, STUTTGART (GERMANY, F.R.).
Significance on the New Large Water Reservoir Schonbuhl and Its Consequences on the Landeswasserversorgung Stuttgart (Die Bedeutung Des Neuen Grossbehalters Schonbuhl Fur Die Landeswasserversorgung Stuttgart),
W83-02963 8A

ACCESSION NUMBER INDEX

W83-02801 6F
W83-02802 5G
W83-02803 8G
W83-02804 5D
W83-02805 5D
W83-02806 5D
W83-02807 5D
W83-02808 6G
W83-02809 2J
W83-02810 2H
W83-02811 6B
W83-02812 5D
W83-02813 5B
W83-02814 5A
W83-02815 5G
W83-02816 5A
W83-02817 5B
W83-02818 5B
W83-02819 5A
W83-02820 5B
W83-02821 5A
W83-02822 2H
W83-02823 5B
W83-02824 5G
W83-02825 2H
W83-02826 2J
W83-02827 4D
W83-02828 2I
W83-02829 5G
W83-02830 5G
W83-02831 5E
W83-02832 6E
W83-02833 5D
W83-02834 5E
W83-02835 5B
W83-02836 3B
W83-02837 8G
W83-02838 3F
W83-02839 3F
W83-02840 2H
W83-02841 5C
W83-02842 4D
W83-02843 5C
W83-02844 5F
W83-02845 3B
W83-02846 5F
W83-02847 5G
W83-02848 5D
W83-02849 5D
W83-02850 5C
W83-02851 5D
W83-02852 5D
W83-02853 5D
W83-02854 5D
W83-02855 5D
W83-02856 3C
W83-02857 5G
W83-02858 5D
W83-02859 7C
W83-02860 5D
W83-02861 5D
W83-02862 6B
W83-02863 5B
W83-02864 5
W83-02865 5B
W83-02866 5G
W83-02867 2L
W83-02868 5G
W83-02869 6B
W83-02870 6F
W83-02871 9C
W83-02872 5D
W83-02873 6F
W83-02874 5G
W83-02875 5G
W83-02876 5G
W83-02877 3E
W83-02878 3D
W83-02879 3E
W83-02880 8B
W83-02881 5G
W83-02882 5D
W83-02883 7A
W83-02884 3E
W83-02885 5B
W83-02886 5E
W83-02887 5B
W83-02888 5B
W83-02889 5B
W83-02890 2G
W83-02891 5B
W83-02892 3C
W83-02893 2E
W83-02894 6D
W83-02895 5B
W83-02896 2F
W83-02897 5G
W83-02898 4A
W83-02899 6B
W83-02900 5D
W83-02901 2E
W83-02902 5D
W83-02903 5D
W83-02904 5A
W83-02905 5G
W83-02906 6G
W83-02907 2I
W83-02908 5B
W83-02909 5D
W83-02910 5D
W83-02911 2D
W83-02912 2F
W83-02913 5B
W83-02914 5A
W83-02915 5G
W83-02916 6G
W83-02917 5D
W83-02918 4D
W83-02919 5C
W83-02920 5E
W83-02921 2J
W83-02922 6E
W83-02923 6E
W83-02924 6A
W83-02925 5B
W83-02926 5F
W83-02927 6C
W83-02928 2L
W83-02929 2G
W83-02930 2F
W83-02931 2G
W83-02932 2B
W83-02933 5B
W83-02934 6B
W83-02935 2F
W83-02936 2J
W83-02937 2K
W83-02938 2G
W83-02939 2J
W83-02940 2G
W83-02941 4A
W83-02942 5B
W83-02943 2C
W83-02944 5C
W83-02945 2J
W83-02946 2E
W83-02947 5D
W83-02948 5F
W83-02949 5F
W83-02950 5F
W83-02951 5F
W83-02952 5D
W83-02953 8A
W83-02954 5C
W83-02955 5D
W83-02956 5B
W83-02957 5A
W83-02958 5C
W83-02959 5F
W83-02960 8E
W83-02961 2J
W83-02962 8F
W83-02963 8A
W83-02964 7B
W83-02965 2D
W83-02966 2D
W83-02967 7A
W83-02968 2K
W83-02969 2E
W83-02970 7A
W83-02971 5B
W83-02972 2F
W83-02973 7A
W83-02974 2E
W83-02975 5A
W83-02976 6G
W83-02977 4B
W83-02978 6G
W83-02979 2E
W83-02980 2F
W83-02981 2E
W83-02982 5B
W83-02983 2E
W83-02984 2D
W83-02985 6G
W83-02986 2L
W83-02987 2F
W83-02988 5G
W83-02989 7C
W83-02990 6D
W83-02991 2F
W83-02992 2E
W83-02993 2F
W83-02994 7C
W83-02995 2G
W83-02996 2G
W83-02997 2G
W83-02998 2G
W83-02999 2G
W83-03000 2G
W83-03001 2G
W83-03002 3F
W83-03003 8B
W83-03004 6E
W83-03005 8C
W83-03006 8C
W83-03007 8C
W83-03008 8C
W83-03009 5A
W83-03010 3A
W83-03011 5B
W83-03012 8A
W83-03013 8A
W83-03014 2G
W83-03015 5B
W83-03016 3C
W83-03017 5C
W83-03018 2E
W83-03019 6E
W83-03020 2F
W83-03021 2F
W83-03022 6E
W83-03023 4A
W83-03024 5B
W83-03025 2G
W83-03026 2G
W83-03027 2G
W83-03028 4A
W83-03029 2J
W83-03030 5B
W83-03031 5C
W83-03032 2J
W83-03033 4B
W83-03034 2D
W83-03035 5C
W83-03036 6G
W83-03037 3F
W83-03038 3F
W83-03039 4D
W83-03040 3A
W83-03041 2K
W83-03042 5B
W83-03043 5B
W83-03044 5B
W83-03045 5B
W83-03046 4B
W83-03047 8G
W83-03048 5B
W83-03049 5B
W83-03050 6G
W83-03051 2L
W83-03052 5B
W83-03053 5B
W83-03054 2C
W83-03055 2L
W83-03056 4B
W83-03057 5B
W83-03058 7A
W83-03059 5G
W83-03060 2A
W83-03061 4A
W83-03062 6A
W83-03063 8B
W83-03064 2L
W83-03065 6E
W83-03066 5F
W83-03067 5F
W83-03068 5F
W83-03069 5F
W83-03070 5E
W83-03071 5F
W83-03072 6G
W83-03073 2H
W83-03074 5C
W83-03075 5C
W83-03076 4C
W83-03077 5A
W83-03078 2H
W83-03079 2H
W83-03080 2H
W83-03081 5C
W83-03082 6A
W83-03083 5B
W83-03084 5A
W83-03085 7C
W83-03086 5C
W83-03087 5C
W83-03088 5F
W83-03089 5F
W83-03090 8D
W83-03091 5G
W83-03092 6C
W83-03093 5C
W83-03094 4A
W83-03095 6B
W83-03096 2J
W83-03097 5D
W83-03098 5F
W83-03099 5F
W83-03100 5D
W83-03101 2F
W83-03102 5E
W83-03103 5C
W83-03104 5A
W83-03105 5A
W83-03106 5F
W83-03107 5D
W83-03108 5B
W83-03109 5C
W83-03110 5B
W83-03111 7B
W83-03112 5B
W83-03113 3A
W83-03114 5B
W83-03115 2H
W83-03116 2J
W83-03117 2J
W83-03118 2J
W83-03119 2K
W83-03120 5D
W83-03121 5D
W83-03122 5E
W83-03123 5D
W83-03124 5D
W83-03125 5D
W83-03126 5D
W83-03127 5D
W83-03128 5D
W83-03129 3F
W83-03130 6B
W83-03131 5A
W83-03132 4B
W83-03133 2J
W83-03134 4D
W83-03135 5E
W83-03136 3D

W83-03137 5D
W83-03138 2G
W83-03139 4C
W83-03140 5G
W83-03141 6B
W83-03142 4B
W83-03143 6B
W83-03144 5B
W83-03145 5A
W83-03146 7C
W83-03147 5G
W83-03148 7C
W83-03149 6G
W83-03150 2J

Subject Fields

- 1 NATURE OF WATER
- 2 WATER CYCLE
- 3 WATER SUPPLY AUGMENTATION AND CONSERVATION
- 4 WATER QUANTITY MANAGEMENT AND CONTROL
- 5 WATER QUALITY MANAGEMENT AND PROTECTION
- 6 WATER RESOURCES PLANNING
- 7 RESOURCES DATA
- 8 ENGINEERING WORKS
- 9 MANPOWER, GRANTS, AND FACILITIES
- 0 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

- SUBJECT INDEX
- AUTHOR INDEX
- ORGANIZATIONAL INDEX
- ACCESSSION NUMBER INDEX

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A19	32.50	E99	**		
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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 16, NUMBER 10
OCTOBER 1983

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 16, NUMBER 10
OCTOBER 1983

W83-03151 -- W83-03500

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
Reston, VA 22092

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

VITRIFICATION OF PURE LIQUID WATER BY HIGH PRESSURE JET FREEZING,
Innsbruck Univ. (Austria). Inst. for Inorganic and Analytical Chemistry.
E. Mayer, and P. Bruggeller.
Nature (London), Vol 298, No 5876, p 715-718, August 19, 1982. 5 Fig, 30 Ref.

Descriptors: *Vitrification, *Freezing, *Ice, Cryogenics, Water properties, Physical properties, *X-ray diffraction patterns, Pure liquid water.

Pure liquid water was vitrified by projecting a thin jet of liquid water at high speed and pressure into a liquid cryomedium. Best vitrification conditions were: aperture, 10 microns; working pressure, 400 atmospheres; cryomedium, liquid propane stirred vigorously at 80K in vacuum. The product was predominantly vitreous or microcrystalline substance with a small amount of crystalline, mainly hexagonal, ice. Devitrification occurred upon warming over a 30 min period to 150K with butene-1 as the cryomedium. Devitrification started at 130K when propane was the cyromdeium. X-ray diffraction patterns of the vitrified liquid water and amorphous solid water prepared from the vapor phase were compared. However, sharp differences in patterns were difficult to discern because of interference by the cryomedia. It was not possible to observe a glass transition temperature in the vitrified water sample. (Cassar-FRC)
W83-03259

2. WATER CYCLE

2A. General

THE EXTENT AND NATURE OF RAINFALL-SOIL INTERACTION IN THE RELEASE OF SOLUBLE CHEMICALS TO RUNOFF,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W83-03170

MODELLING THE FLOOD ALLEVIATION SCHEME FOR THE USK AT BRECON,
For primary bibliographic entry see Field 8B.
W83-03247

HYDROLOGIC FLOW DETERMINATION FOR HYDROPOWER FEASIBILITY ANALYSIS,
Idaho Univ., Moscow. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W83-03271

RESPONSE SURFACE PARAMETER SENSITIVITY ANALYSIS METHODS FOR POSTCALIBRATION STUDIES,
Case Western Reserve Univ., Cleveland, OH. Inst. of Technology.
S. Sorooshian, and F. Arfi.
Water Resources Research, Vol 18, No 5, p 1531-1538, October, 1982. 7 Fig, 3 Tab, 22 Ref. OWRT C-90320(No 9442).

Descriptors: *Rainfall-runoff models, *Watersheds, *Calibrations, Parameters, Runoff, Rainfall, Precipitation, Physical properties, *Sensitivity analysis.

The role of parameter sensitivity analysis for postcalibration studies of conceptual rainfall-runoff models is investigated. Two sensitivity measures, namely, concentricity and interaction, which characterize the shape of the response surface in the neighborhood of the converged point were developed. When used conjunctively, the two measures provide some useful information related to the geometry of the response surface in two-parameter subspaces. The role of these measures for postestimation purposes is demonstrated in the case of a four-parameter model using synthetically generated data. (Baker-FRC)
W83-03293

REGIONAL DETECTION OF CHANGE IN WATER QUALITY VARIABLES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. W. Koch, T. G. Sanders, and H. J. Morel-Seytoux.
Water Resources Bulletin, Vol 18, No 5, p 815-821, October, 1982. 6 Tab, 8 Ref. OWRT B-186-COLO, 14-34-0001-8069.

Descriptors: *Water quality, *Stochastic hydrology, *Variability, Statistical analysis, Hydrology, *Conductivity, *Colorado.

A method is suggested for detecting changes in the mean of hydrologic variables which have a random and stochastic nature. Adapted from the bivariate normal distribution theory, this technique forms variables (both dependent and independent) as weighted linear combinations of the mean values at a number of locations in a selected target (dependent and control (independent) area. Weighting factors are determined by a mathematical programming technique which minimizes the conditional coefficient of variation and in turn the number of observations required to detect a change of preselected magnitude in the mean of the target area. The method was applied to six Colorado river basins in two variations: (1) electrical conductivity data from three stations as the target and three stations as the control, and (2) electrical conductivity data as the target variable and annual discharge as the control. The method detected changes in the mean within a shorter time than traditional tests and was especially effective in cases of high variability and limited numbers of monitoring stations. (Cassar-FRC)
W83-03295

BASIN-SCALE EVAPOTRANSPIRATION DETERMINATION THROUGH WATERSHED AND CLIMATE ANALYSES,
Southern Piedmont Conservation Research Center, Watkinsville, GA.
For primary bibliographic entry see Field 2D.
W83-03328

OBTAINING RAINFALL INTENSITY CURVES FROM MUNICH RAINFALL RECORDS (DIE ERMITTLUNG VON REGENSPENDELINIEN AUS MUNCHNER REGENSCHREIBERAUFZEICHNUNGEN),
Technische Univ., Munich (Germany, F.R.). Lehrstuhl und Pruefamt fuer Wassergutewirtschaft und Gesundheitsingenieurwesen.
For primary bibliographic entry see Field 2B.
W83-03452

MODEL RAINFALL FOR SEWER SYSTEM DESIGN CURRENT KNOWLEDGE AND RECOMMENDATIONS (MODELLREGREN ZUR KANALNETZBEMESSUNG - KENNTNISSTAND UND EMPFEHLUNGEN),
W. Neumann, and F. Rothmeier.
Gas-und Wasserfach: Wasser/Abwasser, Vol 122, No 9, p 396-401, September, 1981. 6 Fig, 11 Ref. English abstract.

Descriptors: *Design storms, *Statistical analysis, *Statistical models, *Rainfall intensity, Storms, Model studies, Mathematical studies, Rainfall, Precipitation intensity, Sewer systems, Computer programs, Simulation, *Federal Republic of Germany, Rainstorms.

Design storms are often used in computer assisted sewer system stimulations. These design storms are derived from simple mathematical transformations of the relationship between average rainfall intensities and rainfall duraTions in response to rainfall frequencies. There are a number of advantages to using these design storms; however, it is still not certain whether or not these artificially constructed, mostly dynamic curves correspond to reality. A statistical analysis of heavy rainfall events was carried out based on long term precipitation data for Munich, Germany. An equation is presented which gives the probability of the dependence of the rainfall intensity maximum on the time occurrence, as well as the dependence of the intensity maximum on mean density. Finally, a percentile listing of 5-minute rainfall amounts in dependence on the total rainfall amount is given. From this, a statistically safe design storm car be derived. (Author's abstract)
W83-03453

IMPROVED FORMULAS FOR ESTIMATING GROUNDWATER SUPPLIES BY SHORT-TERM PRECIPITATION-MINIMUM SERIES (VERBESSERTE ANSATZA FUER DIE SCHATZUNG DER DARGEBOTE VON GRUNDWASSERMENGEN DURCH NIEDERSCHLAGS-MINIMUM-KURZREIHEN),
J. Model.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 8, p 340-344, 1981. 3 Fig, 3 Tab. English abstract.

Descriptors: *Groundwater recharge, *Rainfall intensity, *Mathematical studies, *Meteorological data collection, *Statistical analysis, Rainfall, Recharge, Data collections, Detmold, Federal Republic of Germany.

An evaluation of rainfall observations demonstrated that the arithmetic mean of annual rainfall data for the Administration District of Detmold (Northrhine, Westfalia) for the period 1931-1960 was unusually high. The mean was 12% higher than the mean for short-term periods within the same time range. Also, analysis of the data revealed that dry periods of several years occurred at regular intervals. Rainfall quantity is the essential factor in determining groundwater recharge; thus it is proposed to use the lowest five-year mean annual rainfall within the observation time instead of the arithmetic mean for the total observation period (of 30 years or more). Differences between the use of the lowest five year mean and the total mean are discussed. (Small-FRC)
W83-03461

A METEOROLOGICAL AND CLIMATOLOGICAL APPROACH IN DETERMINING SNOWPACK ACCUMULATION AT SNOW COURSE SITES IN A MONTANA WATERSHED,
Montana State Univ., Bozeman. Dept. of Earth Sciences.
W. B. Tremper, P. J. Dawson, and R. H. Yaw.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-226852, Price codes: A03 in paper copy, A01 in microfiche. Montana Water Resources Research Report No 132, Montana State Univ., Bozeman, June 1983. 29 p, 3 Tab, 3 Fig, 15 Ref, 1 Append. OWRT A-132-MONT(1), 14-34-0001-1128.

Descriptors: *Precipitation (Atmospheric), *Snowfall, *Statistical models, *Snowpack, Snow survey, Water equivalent, Regression analysis, Climatic data, Meteorology, Model studies, SNOTEL, Stepwise multiple regression, Snow course, Correlation coefficients, Mountain snowpack, *Montana.

This study tests the feasibility of adequately estimating snowpack water equivalent at snow course sites in southwest Montana using meteorological parameters along with precipitation and temperature data from local climate stations in an inexpensive statistical model. The model was developed using a sample period of 200 days where weather and climate parameters were entered as independant variables in a statistical stepwise multiple regression equation with daily snowfall at snow course and SNOTEL sites as the dependant variable. The equations generated were then run with data from a 17 year period to estimate monthly snow accumulation at nearby monthly snow course sites, then compared to actual monthly totals to determine the success of the model. Using this methodology, the results show that estimates of monthly snow accumulation correlate with actual values with correlation coefficients of 0.90

and above for six of the twelve snow course sites tested (highest, 0.98) and 0.84 and above for 11 of the 12 sites. This methodology could augment snow course measurements or, in some cases, replace snow courses. This methodology can easily be used in other locations to estimate mountain snowpack in a cost effective manner as long as the area in question has representative records of daily mountain snowfall and corresponding local climate station records.
W83-03465

MATHEMATICAL MODELING IN URBAN HYDROLOGY,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
J. W. Delleur.
In: Proceedings, Applied Modeling in Catchment Hydrology, Symposium atUniversity of Mississippi, May 1981. Water Resources Research Center, 1982, p 399-419, 44 Ref., V. P. Singh, ed.

Descriptors: *Urban runoff, *Mathematical models, Urban hydrology, Model studies.

The use of the rational formula for modeling urban runoff is rapidly decreasing. Hydrograph applications have received renewed attention due to the fact that hydrograph identification and convolution can be performed very simply on small programmable calculators. Several synthetic unit hydrographs and instantaneous unit hydrographs have recently been proposed. The formulations of a design storm may be either in the form of a uniform intensity for a given duration and recurrent interval on the development of a synthetic hyetograph. Recent research shows that the design storm and antecedent soil moisture conditions have important effects on the peak flow-frequency curve. One of the simpler techniques for estimating the initial and infiltration losses is the Soil Conservation Service Curve Number Method while a more sophisticated one is used in the parametric-deterministic ADS model of the USGS. Recent improvements of some of the large scale models such as SWMM, STORM, and new versions of ILLUDAS are presented. The ADS model and SMADA (Storm Management and Design Aid) are discussed briefly. Among the methods for obtaining the least cost drainage systems are the discrete differential dynamic programming (DDDP) model and the coupling of a hydrologic model such as ILLUDAS with a dynamic programming subroutine.
W83-03486

2B. Precipitation

COMPARATIVE STUDY OF THE CAUSES AND EFFECTS OF RECENT SOUTHEASTERN DROUGHTS,
Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
M. V. Paris, and C. G. Justus.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220343. Environmental Resources Center Report No ERC 03-83, Georgia Institute of Technology, Atlanta, April 1983. 63 p, 28 Fig, 11 Tab, 7 Ref, 1 Append. OWRT A-097-GA(1), 14-34-0001-2111.

Descriptors: *Circulation patterns, *Drought, *High pressure, Lake levels, *Precipitation, *Streamflows, Georgia, Texas, Gulf of Mexico, Southeast U.S., Moisture deficit.

The visible effects in Georgia of the 1980-81 drought, such as lower than normal lake levels, caused much public concern. This study examines the effects of the 1980-81 drought and compares them to an earlier drought in 1954-55 to determine whether the effects were more severe than precipitation amounts alone would have indicated. The location of high pressure in the Gulf of Mexico is also examined to determine whether precipitation amounts in summer months can be related to changes in normal circulation patterns. Data on precipitation for Georgia cities, regions and the entire state, as well as Texas regional precipitation, are examined. Stream flows and lake levels in Georgia are examined and compared to state-wide precipitation. Weather maps are examined for July and August in drought and non-drought years to determine circulation patterns. The 1980 drought is found to be less severe in precipitation deficit than 1954-55 and the effects on stream flows and lake levels are found to be less severe than precipitation amounts alone would have indicated, when compared to 1954-55, with the exception of one lake. A relationship is found between changes in normal circulation patterns and lower-than-normal precipitation in Georgia. Some indications are found that high pressure in the eastern Gulf of Mexico might cause higher-than-normal precipitation in Gulf Coastal Texas, while high pressure in the western Gulf might cause lower-than-normal precipitation in Gulf Coastal Texas.
W83-03297

RAINFALL CELL SIZE FROM RIT CURVE ANALYSIS,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
C. M. Fullerton, S. K. Wilson, and A. Austring.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222372, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 136, UHMET 80-6, June 1980. 85 p, 7 Fig, 11 Tab, 18 Ref, 5 Append. OWRT A-059-HI(2), 14-34-0001-6012.

Descriptors: *Rainfall intensity, *Weather patterns, Hydrometeorology, Rain gages, Meteorological data, *Hawaii, *High intensity rainfall, *Rainfall intensity-time (RIT) curves, Rainfall characteristics, Meteorological parameters, Hilo.

A small and closely-spaced network of three to seven rapid response (4-s) rainfall intensity gages has been used to measure intense, short duration rain showers on the windward (eastern) coast of Hawaii Island. During a one year, intensive monitoring period, 54 events were recorded with rainfall intensities greater than 95 mm/hr on at least one gage. Four of these events had peak rainfall rates greater than 250 mm/hr. The 54 events were analyzed in an attempt to derive some properties characteristic of individual high intensity rainfall-producing 'cells'. A total of 75 cells, involving 397 separate gage measurements, were extracted from the 54 events by applying an 11-point running mean, averaging technique. The cell data were studied by sorting the rainfall intensity-time plots into curves of symmetrical shape (35.5%), and those exhibiting a positive (43%) or a negative (21.5%) skew. Normalized mean curves than were constructed for each of these three types. Ten cases appeared to involve multiple, overlapping cells, including two cases of long duration thunderstorm rainfall. These ten events were excluded from the results listed below. The average of the 65 single cell cases produced about 5 mm of rain in about 5.5 min, with an average maximum rainfall rate of about 110 mm/hr. The ground rainfall pattern moved across the network with an average speed of about 6.5 m/s. If the cell is assumed to be circular across a plane parallel with the ground, these results imply a mean cell diameter of about 2 km and an average cross-sectional cell area of about 3.2 km super 2.
W83-03339

OBTAINING RAINFALL INTENSITY CURVES FROM MUNICH RAINFALL RECORDS (DIE ERMITTLUNG VON REGENSPENDELINIEN AUS MUNCHNER REGENSCHREIBERAUFZEICHNUNGEN),
Technische Univ., Munich (Germany, F.R.). Lehrstuhl und Pruefamt fuer Wassergutewirtschaft und Gesundheitsingenieurwesen.
F. Rothmeier, and W. Neumann.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 2, p 64-68, February, 1981. 5 Fig, 4 Tab, 5 Ref. English abstract.

Descriptors: *Design storms, *Statistical analysis, *Rainfall intensity, *Sewer systems, *Rainfall distribution, Rain gages, Rainstorms, Precipitation intensity, Storms, Mathematical studies, Munich, *Federal Republic of Germany.

Within a special research program the German Research Society funds a study on the statistical analysis of rainfall properties to describe the design storms for sewer planning. The data base consists of raingauge records over a period of 24 years for five Munich raingauges. With an automatic digitizer, a careful evaluation of the variation in rainfall intensity was possible. Part of the research work was the revision of the relationship between average rainfall intensities and rainfall durations in response to rainfall frequencies. It can be shown that the well-known Reinhold relationship of rainfall intensity/duration/frequency can be maintained if the one-year base intensity of 15-minutes duration is modified. (Author's abstract)
W83-03452

NUMERICAL SIMULATION OF LAND-BREEZE-INDUCED SNOWBANDS ALONG THE WESTERN SHORE OF LAKE MICHIGAN,
Wisconsin Univ.-Milwaukee. Dept. of Atmospheric Sciences.
For primary bibliographic entry see Field 2C.
W83-03482

2C. Snow, Ice, and Frost

CALVING SPEED OF ALASKA TIDEWATER GLACIERS, WITH APPLICATION TO COLUMBIA GLACIER,
Geological Survey, Tacoma, WA. Water Resources Div.
C. S. Brown, M. F. Meier, and A. Post.
Available from the Distribution Branch 604 S. Pickett St., Alexandria VA, Price: $5.00. Geological Survey Professional Paper 1258-C, 1982. 13 p, 6 Fig, 4 Plates, 7 Tab, 24 Ref.

Descriptors: *Glaciers, *Icebergs, *Bathymetry, Glacier mass balance, Velocity, *Alaska, *Columbia glacier, Calving glacier.

Columbia Glacier is a grounded, tidewater glacier, 1,100 square kilometers in area, which actively calves icebergs from its terminus. Calving speed, defined as the volume rate of iceberg discharge from the terminus divided by the cross-sectional area of the terminus, depends on measurable properties of the terminus and this relationship forms the terminus boundary condition for predictive models. Calving speed is the difference between glacier speed and the rate of terminus advance. The mean yearly calving speed calculated in this way for 12 glaciers in Alaska ranges from 220 to 3,700 meter per year. Yearly calving speeds estimated using balance flux and thinning flux for three additional glaciers that recently underwent rapid retreat extend the range of calving speed to 12,500 meter per year. A statistical analysis of calving speed and mean yearly values for water depth, cliff height, and glacier thickness at the terminus indicates that calving speed is fit best by a simple proportionality to average water depth at the terminus, with a constant of proportionality equal to 27 per year, producing a variance reduction fraction of 0.90. This calving relation using mean yearly values and a proposed seasonal calving relation involving runoff as a variable do not appear to be compatable. (USGS)
W83-03358

BACKWATER CURVE COMPUTATIONS UNDER ICE COVERS IN THE LA GRANDE RIVER (COURBES DE REMOUS SOUS LES COUVERTS DE GLACE DE LA GRANDE RIVIERE),
Laval Univ., Quebec. Dept. of Civil Engineering.
B. Michel, and M. Drouin.
Canadian Journal of Civil Engineering, Vol 8, No 3, p 351-363, September, 1981. 15 Fig, 10 Ref. English summary.

Descriptors: *Ice cover, *Rivers, *Mathematical studies, *Backwater curve, *Ice formation, Ice, Flow profiles, Mathematical equations, Ice thickness, Freezing, La Grande River, *Quebec, Canada.

The problem of backwater curve computations under ice covers is very complex. On top of the difficulties which are inherent to computation of backwater curves under open water flow conditions, the ice cover has to be taken into account. The ice cover's thickness and roughness are time dependent because of variable flow and weather conditions. One of the major factors is the formation of hanging ice dams, especially in most northern rivers. A complete method for the computation of backwater curves is presented based on the mechanisms of ice formation: the law of equilibrium of the frontal edge, the accumulation of ice under this edge, thermal growth, and the equilibrium of hanging dams. The method is based upon measurements taken in the La Grande River (Quebec, Canada). (Author's abstract)
W83-03395

A METEOROLOGICAL AND CLIMATOLOGICAL APPROACH IN DETERMINING SNOWPACK ACCUMULATION AT SNOW COURSE SITES IN A MONTANA WATERSHED,
Montana State Univ., Bozeman. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2A.
W83-03465

NUMERICAL SIMULATION OF LAND-BREEZE-INDUCED SNOWBANDS ALONG THE WESTERN SHORE OF LAKE MICHIGAN,
Wisconsin Univ.-Milwaukee. Dept. of Atmospheric Sciences.
R. J. Ballentine.
Monthly Weather Review, Vol 110 , No 11, p 1544-1553, November, 1982. 15 Fig, 8 Ref.

Descriptors: *Model studies, *Atmospheris physics, *Lakes, Great Lakes, *Lake Michigan, Snow, Wind, Snowbands, Snowfall.

Case studies are presented which describe a type of lake-effect snowband which forms along the western shore of Lake Michigan when a cold anticyclone to the north sets up an easterly gradient over the lake. Numerical simulations indicate that the snowband coincides with a narrow band of upward motion which results from the convergence of easterly winds over the lake and north to northwesterly winds over land. The northerly winds are part of a land breeze circulation which forms when cold air is heated by the relatively warm lake surface. Initial data for model simulations are obtained by objective analysis of upper-air data from the eight upper-air stations closest to Lake Michigan at six levels in the lower troposhere. Model results show that a pool of cold air over the lake up to about 850 mb favors rapid growth of the planetary boundary layer over the western half of the lake, and that the latent heat release plays an important role in intensifying the land breeze circulation. (Baker-FRC)
W83-03482

2D. Evaporation and Transpiration

CONTRIBUTION TO THE MEASUREMENT OF EVAPORATION IN REMOTE STATIONS (BEITRAG ZUR VERDUNSTUNGSMESSUNG IN ABGELEGENEN STATIONEN),
Salzgitter A.G. (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W83-03225

MEASUREMENT OF ACTUAL TRANSPIRATION OF NATIVE GRASS STANDS AS A COMPONENT OF NEBRASKA SANDHILLS GROUNDWATER HYDROLOGY,
Nebraska Univ., Lincoln. School of Life Sciences.
A. T. Harrison.
Nebraska Water Resources Center Completion Report, Univ. of Nebraska, Lincoln, June 1983. 45 p, 2 Fig, 3 Tab, 26 Ref. OWRT A-066-NEB(1), 14-31-0001-9129.

Descriptors: *Transpiration, *Evapotranspiration, *Consumptive use(Water), Groundwater hydrology, Hydrologic cycle, Vegetation, Grasslands, Soil moisture, Natural recharge, Plant physiology, *Nebraska, Sandhills soil types.

Objectives of this project were: (1) to quantify the role of native vegetation in site-specific evapotranspiration and to document consumptive use by native grass species on different Sandhills soil types; and (2) to identify which vegetation/soil sites may act as important hydrologic water table recharge sites based on site-specific precipitation/transpiration/percolation dynamics. Data were collected on plant physiology and water stress relationships and consumptive use at three major topographic/soil/vegetation sites in Arthur County, NE. Data on transpiration use by 5 dominant Sandhills grass species were collected in addition to gravimetric soil moisture, bulk density and texture, all at 4 topographic sites at 40 to 140 cm intervals in the soil profile. Consumptive water use during a 90-day experimental period was estimated from soil moisture changes in the 140 cm profile assuming no growing season percolation occurred below 140 cm and correcting precipitation events for litter interception. Consumptive use values for the 90 days are surprisingly similar at 230 mm, 230 mm, and 213 mm for ridge, slope and swale sites, respectively. Total soil moisture withdrawal was least at the swale site (-31 mm) due to the shallow rooted western wheatgrass which dominates the site. Soil moisture withdrawal at the slope and ridge sites, dominated by deeply rooting warm season grasses, was -47 mm and -39 mm, respectively. During 1979, season end soil moisture profile deficits ranged from approximately 100 mm in the ridge profile to 250 mm in the swale site.
W83-03312

BASIN-SCALE EVAPOTRANSPIRATION DETERMINATION THROUGH WATERSHED AND CLIMATE ANALYSES,
Southern Piedmont Conservation Research Center, Watkinsville, GA.
L. A. Harper, W. M. Snyder, and D. W. Kolberg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222174, Price codes: A04 in paper copy, A01 in microfiche. Environmental Resources Center Report No ERC 01-83, Georgia Institute of Technology, Atlanta, April 1983. 48 p, 12 Fig, 7 Tab, 11 Ref, 1 Append. OWRT A-103-GA(1), 14-34-0001-2111.

Descriptors: *Deep seepage, *Drainage, *Evaporation, Models, Precipitation, Rainfall, Runoff, *Seepage, *Water yield, Model studies, *Georgia, Watershed management, Water loss.

A model was developed to express evapotranspiration as a function of recovery of basin storage between storms. The model was designed for calibration using historical hydrologic data. Five parameters, structured to estimate evapotranspiration as a function of pan evaporation, and three parameters, expressing deep seepage, were evaluated simultaneously using non-linear least squares. A water-yield model that had been developed earlier was also calibrated against the same historical data for purposes of comparison. The same optimizing technique of non-linear least squares was used. It was found that the newly-developed basin-scale evapotranspiration model could not be satisfactorily optimized. While the model had been designed to assign structural roles to the parameters, the derived numerical values were not rational relative to these structures. The water yield model was successfully optimized on data sets from four drainage areas. Since water-yield models must inherently contain some expression of evapotranspirative losses in their structures, an attempt was made to re-interpret results of the successful optimizations. Delayed runoff could be calculated for each calendar month for up to six months following the month of rainfall input. The summation of these delayed amounts is potential runoff - that total runoff which is ascribable to rainfall of any month, regardless of the month in which the flow is delivered to the streamgage. Potential runoff subtracted from rainfall yields a difference that can be called 'not runoff'. The 'not runoff' amount is comprised to two major 'water loss' components, evapotranspiration and deep seepage. The 'not runoff' values were plotted by calendar month for three of the four basins that had continous flow. The seasonal patterns of these 'not runoff' values are so pronounced and consistent among the three drainages that the two loss components, evapotranspiration and deep seepage, can be identified.
W83-03328

FIELD STUDY OF ACTUAL EVAPOTRANSPIRATION OF A WHEAT CROP (ETUDE 'IN SITU' DE L'EVAPOTRANSPIRATION REELLE D'UNE CULTURE DE BLE),
Institut National de la Recherche Agronomique, Versailles (France). Station de Bioclimatologie.
A. Perrier, N. Katerji, G. Gosse, and B. Itier.
Agricultural Meteorology, Vol 21, No 4, p 295-311, May, 1980. 5 Fig, 2 Tab, 16 Ref. English summary.

Descriptors: *Evapotranspiration, *Crop yield, *Wheat, Water balance, Rainfall, Humidity.

The evapotranspiration of a wheat crop was studied over two consecutive years and determined by an automated energy balance system. Results were analyzed to examine the role played by meteorological factors, excluding indirect biological effects, and separately by physiological factors, on the variations in evapotranspiration. Even with the large difference in rainfall, and consequently the water balance, in the two years 1975 and 1976, it clearly appeared that the critical evapotranspiration plays a dominant role, together with the regular physiological development related to the aging of the crop, as indicated by the mean crop resistance. The good relationship between this mean crop resistance and the critical resistance defined by meteorological factors alone may be explained by the classical response of stomatal aperture to light and atmospheric humidity. Nevertheless, this relationship may suggest the definition of a specific ratio between actual evapotranspiration and the critical value of evapotranspiration, a result which can be very useful in practice. (Baker-FRC)
W83-03389

2E. Streamflow and Runoff

FIELD RATING EVALUATION OF A LARGE SUPERCRITICAL MEASUREMENT FLUME,
For primary bibliographic entry see Field 7B.
W83-03239

WINTER OF FROSTS, FLOODS AND BURSTS.
For primary bibliographic entry see Field 5F.
W83-03244

HYDROLOGIC FLOW DETERMINATION FOR HYDROPOWER FEASIBILITY ANALYSIS,
Idaho Univ., Moscow. Dept. of Civil Engineering.
J. R. Filler, and C. C. Warnick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219758, Price codes: A03 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Univ. of Idaho, Moscow, December 1982, 43 p, 7 Fig, 8 Tab, 17 Ref. OWRT A-068-IDA(2). 14-34-0001-2114.

Descriptors: *Rainfall-Runoff relationship, *Hydrologic data, *Water yield, *Duration curves, Runoff coefficient, Streamflow, Runoff feasibility, *Feasibility studies, Small watersheds, Hydroelectric power, *Idaho.

A study was made of methods for determining average annual runoff from ungaged watersheds and the use of such runoff in the estimation of flow duration curves for hydropower feasibility studies. Methods included the use of precipitation-input maps, water yield maps, and regression equations utilizing basin characteristics. The various methods were tested on gaged and ungaged watersheds in Idaho and results compared with each other, as well as the actual flow measurements. The use of watershed characteristics such as mean basin elevation, cover density, and annual precipitation were tested and compared and it was found that precipa-

tion alone provided the best and simplest approach for determining runoff. New concepts for using watershed parameters of mean basin elevation, relative topographic relief, and basin slope were proposed and briefly tested. Additional research on the inclusion of watershed characteristics and field measurement for verification is recommended.
W83-03271

GEOHYDROLOGY OF THE RIO CAMUY CAVE SYSTEM, PUERTO RICO,
Puerto Rico Univ., Mayaguez.
For primary bibliographic entry see Field 2F.
W83-03283

URBAN FLOOD DAMAGE ESTIMATING CURVES,
Georgia Inst. of Tech., Atlanta.
T. N. Debo.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1059-1069, October, 1982. 5 Fig, 5 Tab, 6 Ref. OWRT A-081-GA.

Descriptors: *Urban watersheds, *Flood damage, *Flood plain management, *Georgia, Land use, Planning, Flood frequency, Storm water, Flood plain zoning, Hydrologic maps.

Flood damage curves for the state of Georgia were developed using an economic computer model. Stage-frequency data, depth-damage data, physical data, and land value data were used to generate damage frequency curves from estimated damages caused by floods of 7 frequencies from 2 to 100 years. The curves apply only to the state of Georgia. They can be used to quickly estimate flood damage potential of small and large flood plain areas. The preliminary damage values can be used in planning further studies or storm water management programs, estimating damage potential with different land uses, identifying areas with the greatest damage potential and areas with no flood potential, determining the effects of land use patterns on flood damages, and estimating average annual flood damages. The curves cannot be used to obtain accurate estimates or damage estimates for specific structures. The method concerns only residential land uses, not commercial or industrial land uses. The annual flood damage estimates for five study areas were determined: Columbus, $34,500; DeKalb County, $3,144,200; Macon, $273,300; Rome, $332,600; and Waycross, $20,000. (Cassar-FRC)
W83-03294

LARGE ORGANIC DEBRIS AND ANADROMOUS FISH HABITAT IN THE COASTAL REDWOOD ENVIRONMENT: THE HYDROLOGIC SYSTEM,
California Univ., Santa Barbara. Dept. of Geological Sciences.
E. A. Keller, and A. MacDonald.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222240, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center Completion Report, University of California, Davis, June 1983. 48 p, 13 Fig, 2 Tab, 33 Ref. OWRT-B-213-CAL(1).

Descriptors: *Detritus, *Anadromous fish, *Aquatic habitats, *Environmental effects, Fish behavior, Fish populations, Sedimentation, Coastal streams, Channels, *California, Redwood Creek watershed, Redwood National Park.

New ways to evaluate discrete hydrologic environments, such as pools, riffles and debris accumulations were developed. Experiments completed provided basic data to test a model useful for predicting hydraulic geometry of pools and riffles. These experiments will help managers develop design criteria for construction or improvement of fish habitat in channel restoration projects. Similar hydrologic experiments in Redwood National Park, have been completed to evaluate the stream power associated with organic steps and defines a sediment buffer system that modulates the movement of bedload through the fluvial system. A second line of inquiry involved debris removal experiments in Redwood National Park. Significant hydrologic and morphologic changes occurred as a result of the debris removal. Results of the debris pulling experiment suggest that the stream now is more sluggish and has less hydrologic variability than prior to the debris removal. The third line of inquiry was a comparative study between undisturbed streams flowing through old growth redwood forest with those impacted by timber harvesting. (Snyder-California)
W83-03335

THE FLOOD MITIGATION POTENTIAL OF INLAND WETLANDS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W83-03349

JOHNSTOWN-WESTERN PENNSYLVANIA STORM AND FLOODS OF JULY 19-20, 1977,
Geological Survey, Harrisburg, PA. Water Resources Div.
L. R. Hoxit, R. A. Maddox, C. F. Chappell, and S. A. Brua.
Available from Distribution Branch, 604 S. Pickett St., Alexandria, VA 22304, Price $5.00. Geological Survey Professional Paper 1211, 1982. 68 p, 34 Fig, 5 Tab, 26 Ref.

Descriptors: *Boundary processes, *Flash floods, *Flood peak, *Thunderstorms, *Dam failure, Flood damage, Flood recurrence interval, Channel improvement, Convection, High water mark, Rainfall, Weather forecasting, *Pennsylvania, Johnstown, Conemaugh River basin.

Widespread thunderstorms associated with two major squall lines, moved across Pennsylvania between the afternoon of July 19 and morning of July 20, 1977. The western part of outflow boundary produced by the second line became almost stationary in western Pennsylvania and resulted in 6 to 9 hours of nearly continuous thunderstorms. More than 6 inches of rain fell over a 400-square-mile area during this period. In the hills just north and east of Johnstown, rainfall totals were as much as 12 inches. Flash flooding was severe as the storms moved slowly southeastward across the Allegheny, Susquehanna, and Potomac River basins. Peak natural runoff rates greater than 1,000 cubic feet per second per square mile were common for streams draining up to 10 square miles. At eight gaging stations, recurrence intervals for the peak discharges were estimated to be 100 years or more. In addition to high surface runoff, some disasterous flooding also resulted from the failure of seven earthfill-gravity-type dams. At least 78 deaths were attributed to the flooding and eight persons were still listed as missing 1 year later. Total damages in the eight-county flood area were extremely high, possibly exceeding $500 million. (USGS)
W83-03357

VERIFICATION OF STEP-BACKWATER COMPUTATIONS ON EPHEMERAL STREAMS IN NORTHEASTERN WYOMING,
Geological Survey, Lawrence, KS. Water Resources Div.
S. A. Druse.
Available from Br. of Distr., USGS, 604 S. Pickett St., Alexandria, VA 22304, Price $2.75. Geological Survey Water-Supply Paper 2199, 1982. 12 p, 13 Fig, 1 Ref.

Descriptors: *Ephemeral streams, *Streamflow, *Discharge measurement, Backwater, Flow profiles, Stage-discharge relations, *Wyoming, *Step-backwater computations.

Step-backwater computations were verified by subsequent discharge measurements at three ephemeral streamflow stations in northeastern Wyoming. The standard step-backwater method for gradually varied, subcritical flow was used in computing the water-surface profiles and stage-discharge ratings. Stage-discharge rating curves and discharge measurements are illustrated for the three sites, with lines of 15% departure from the rating curves drawn to measure accuracy of the results. All discharge measurements showed departures of less than 15% at the more critical high end of the rating curves. (USGS)
W83-03366

BACKWATER CURVE COMPUTATIONS UNDER ICE COVERS IN THE LA GRANDE RIVER (COURBES DE REMOUS SOUS LES COUVERTS DE GLACE DE LA GRANDE RIVIERE),
Laval Univ., Quebec. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2C.
W83-03395

2F. Groundwater

RADIOELEMENTS, RADIOGENIC HELIUM AND AGE RELATIONSHIPS FOR GROUNDWATERS FROM THE GRANITES AT STRIPA, SWEDEN,
Royal Military Coll. of Science, Shrivenham (England).
J. N. Andrews, I. S. Giles, R. L. F. Kay, D. J. Lee, and J. K. Osmond.
Geochimica et Cosmochimica Acta, Vol 46, No 9, p 1533-1543, September, 1982. 7 Fig, 3 Tab, 28 Ref.

Descriptors: *Geochemistry, *Granites, *Radioisotopes, *Uranium radioisotopes, *Groundwater dating, Hydrologic models, Radium radioisotopes, Helium, Radon, Groundwater, Geologic fractures, *Sweden.

The geochemistry and isotopic relationships of uranium (U), radium (Ra), radon (Rn), and radiogenic helium (He) in groundwaters from the Stripa granite, Sweden, were examined in connection with groundwater evolution and aging. The solution of radiogenic He and these radioelements in fractured rocks is dependent upon their distribution in the rock matrix and the extent of the rock-water interface. The U234/U238 activity ratio and the dissolved U, Rn and He contents of such groundwaters are affected by changes in the flow regime with time. The U234/U238 activity ratio is strongly influenced by the U distribution within fractures, the extent of the rock-water interface, and the concentration of U238 in solution. These effects may be quantitatively evaluated by models for a fractured crystalline rock in which the U is localized in microfractures and grain boundaries. Groundwaters from depths up to 880 m in the Stripa granite have variable dissolved U contents and U234/U238 activity ratios. The geochemistry of U is determined primarily by variations in flow path rather than by groundwater age. Dissolved radiogenic He in groundwaters increases with depth and is dependent upon the U content and fracture porosity of the granite. The content of radiogenic He increases with groundwater residence time. However, the movement of radiogenic He by diffusion and transport processes makes it impossible to determine the actual groundwater age. (Geiger-FRC)
W83-03208

EXTREME FRACTIONATION OF U234/U238 AND TH230/U234 IN SPRING WATERS, SEDIMENTS, AND FOSSILS AT THE POMME DE TERRE VALLEY, SOUTHWESTERN MISSOURI,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2K.
W83-03209

INVESTIGATIVE PROGRAMS FOR DESIGNING AND MODELING MINE WATER CONTROL SYSTEMS,
International Engineering Co., Inc., San Francisco, CA.
For primary bibliographic entry see Field 4B.
W83-03265

GEOHYDROLOGY OF THE RIO CAMUY CAVE SYSTEM, PUERTO RICO,

Puerto Rico Univ., Mayaguez.
A. Torres-Gonzalez, E. Aguilar, and G. Pannela.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219972, Price codes: A04 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Mayaguez, May 1983. 57 p, 20 Fig, 3 Tab, 20 Ref. OWRT A-053-PR(1), 14-34-0001-8041.

Descriptors: *Hydrogeology, *Underground streams, *Caves, *Puerto Rico, *Underground rivers, Rio Camuy River.

The Rio Camuy, a major river on the northwest coast of Puerto Rico, flows underground for straight-line distance of about 6 kilometers. This underground journey through part of the 15 kilometer long Rio Camuy Caves System is the largest of the island and perhaps the most spectacular in the western hemisphere. The rocks making up the lithologic framework of the cave system all belongs to the Lares Limestone. A relation exists between the system development and fractures, but lineating alone cannot justify the formation of a complex and gigantic cave system as that of the Rio Camuy. Sea Level fluctuations have played th most determinant role in the karstification of the Lares Limestone. Streamflow and rainfall records indicated that 1) the travel time of Rio Camuy through the underground passages fluctuated from 2.5 to 9 hours and 2) the highest recorded flow passing through Blue Hole was about 3,000 cfs. Its maximum intake capacity is estimated in about 4,000 cfs. The towns of Hatillo and Camuy are protected from catastrophic floodings thanks to this natural flood control structure or even more, during hurricane flows. The discovery of a new passage of the cave in February 1980, has demonstrated the existance of a second resurgence through which Rio Camuy overflows to the surface. Dye tests, hydrochemical analyses and numerous cave systems, conducted during the course of this investigation, have proven the existence of hypothetical passage connections.
W83-03283

THE GROUNDWATER BUDGET OF LAKE WINGRA, DANE COUNTY, WISCONSIN,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
D. F. Pennequin, and M. P. Anderson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220525, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center Technical Report WIS WRC 83-01, Univ. of Wisconsin, Madison, 1983. 43 p, 18 Fig, 5 Tab, 23 Ref. OWRT A-092-WIS(1), 14-34-0001-1153.

Descriptors: *Aquifers, Field studies, Groundwater, *Lakes, *Model studies, *Piezometers, Computer models, Darcy's law, *Groundwater budget, *Groundwater movement, Lake beds, Lake shores, Seepage, *Wisconsin, Lake Wingra.

The groundwater circulation pattern and a groundwater budget were established for the late spring and summer of 1981 for Lake Wingra, Madison, Wisconsin. Minipiezometers and conventional piezometers emplaced in the lakebed and the shore sediments showed that groundwater generally flows into the lake from the west, north, and south shores and leaves the lake through the east shore. Daily and weekly water level measurements showed that the overall configuration of the groundwater system around and below the lake is stable. However, the hydrogeologic system around Lake Wingra is permanently in a transient state because the groundwater levels fluctuate continuously. The groundwater budgets for the lake for August 1981 and for the period June to August 1981 were established using mini-piezometers, in-lake and onshore piezometers, and a standard Darcy's law approach. A finite-difference cross-sectional model was used to estimate hydrogeologic and geologic parameters needed to calculate the groundwater budget for the lake. Groundwater seeps into the lake at an average rate of about 0.3 ft sub 3/sec, and out of the lake at rates of 0.08 to 0.09 ft super 3/sec. These in- and out-seepage rates are significantly lower than those previously estimated, but are believed to be more accurate because of the more numerous field data available for use in this study.
W83-03305

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-5A, H-5B, AND H-5C, AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2K.
W83-03360

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-6A, H-6B, AND H-6C, AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2K.
W83-03361

ENVIRONMENTAL ISOTOPIC AND HYDROGEOCHEMICAL INVESTIGATION OF RECHARGE AND SUBSURFACE FLOW IN EAGLE VALLEY, NEVADA,
Nevada Univ. System, Reno. Desert Research Inst.
J. E. Szecsody, R. L. Jacobson, and M. E. Campana.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224402, Price codes: A07 in paper A01 in microfiche. Publication No 42037, April 1983. 120 p, 39 Fig, 7 Tab, 85 Ref, 3 Append. OWRT B-123-NEV(1), 14-34-0001-1244.

Descriptors: *Stable isotopes, *Tritium, *Carbon radioisotopes, *Groundwater recharge, Subsurface flow, Hydrogeochemistry, Groundwater age dating, Eagle Valley, *Nevada, Lysimeters, Snow sampling, Water analysis, Water chemistry, Isotope analysis.

Snow sampling in the main recharge area of Eagle Valley indicates nonequilibrium fractionation of stable isotopes according to the relationship: the variation of D/H = 6.0(the variation of super 18 0/super 16 0)-14. There is a significant correlation between isotopic depletion and elevation, as indicated by: the variation of D/H = -9.9 degrees / oo/1000 ft and the variation of 18/16 = -1.48 degrees /oo/1000 ft. Electrical conductivity and chloride enrichment from snow to lysimeter water produces an estimate of 3900 acre-ft/year of potential recharge to Eagle Valley from the Carson Range. Monitoring of lysimeters throughout the winter shows that the ground is not necessarily frozen under snow and that infiltration and recharge can occur during the winter. Contour maps of sulfate, chloride, sodium, and deuterium concentrations in the valley aquifer suggest thermal/nonthermal water mixing. Aquifer stable isotope values and recharge area values indicate recharge to the aquifer via stream channel infiltration and deep percolation-fracture flow. Tritium and carbon-14 dating of nonthermal water in the aquifer indicates recharge from the Carson Range and in the vicinity the Carson River, with the oldest non-thermal water in the basin center. Carson Hot Springs is about 12,500 years old and is isotopically depleted, whereas Prison Hot Springs contains recent water and is not depleted.
W83-03380

'GEOTHERMAL MINERAL EQUILIBRIA.' REPLY TO A COMMENT BY M. A. GRANT,
Department of Scientific and Industrial Research, Petone (New Zealand). Chemistry Div.
For primary bibliographic entry see Field 2K.
W83-03416

EFFECTS OF GROUNDWATER PUMPAGE ON SURFACE AND GROUNDWATER FLOWS ON ADJOINING BASINS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 4B.
W83-03431

ON THE LACK OF A UNIQUE RELATION BETWEEN C02 PARTIAL PRESSURE AND TEMPERATURE IN GEOTHERMAL SYSTEM. COMMENT ON 'GEOTHERMAL MINERAL EQUILIBRIA' BY W. F. GIGGENBACH,
Department of Scientific and Industrial Research, Wellington (New Zealand). Applied Mathematics Div.
For primary bibliographic entry see Field 2K.
W83-03434

MODIFIED MONTHLY MINIMUM METHOD FOR RAPID CALCULATION OF GROUNDWATER RECHARGE FROM RECEIVING STREAM RUNOFF (DAS MODIFIZIERTE VERFAHREN MOMNO (R12) ZUR RASCHEN ERMITTLUNG DER GRUNDWASSERNEUBILDUNGSRATE AUS DEM VORFLUTERABFLUSS),
Geologisches Landesamt Baden-Wuerttemberg, Freiburg im Breisgau (Germany, F.R.).
E. Villinger.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 8, p 335-339, 1981. 3 Fig, 1 Tab, 8 Ref. English abstract.

Descriptors: *Groundwater recharge, *Surface runoff, *Mathematical studies, *Graphical methods, *Hydrographs, Recharge, Hydrography, Groundwater, Runoff, Geohydrology, Catchment areas.

The rate of groundwater recharge within a catchment area can be determined from the runoff in the receiving stream. For this purpose the runoff must be divided into a surface water component A(o) and a groundwater component A(u); the latter is assumed to be equal to the amount of groundwater recharge. The determination of A(u) is done by graphical separation on a hydrograph constructed from the average low water discharge for each of 12 months. This new method is very simple and gives quick, reliable results. (Author's abstract)
W83-03447

RELIABILITY AND VERIFICATION OF GEOHYDROLOGIC MODELS (ZUVERLASSIGKEIT UND VERIFIKATION VON GEOHYDROLOGISCHEN MODELLEN),
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
A. Obdam.
Gas- und Wasserfach Wasser/Abwasser, Vol 122, No 5, May, 1981. 4 Fig, 4 Tab, 4 Ref. English abstract.

Descriptors: *Model studies, *Mathematical models, *Geohydrology, *Interfaces, Analysis of variance, Statistical analysis, Groundwater, Groundwater flow, Saline water intrusion, Saline freshwater interfaces.

The reliability of a geohydrological model was determined by examining various possible sources of error including the scheme of the model, the system parameters, the boundary conditions, and the initial conditions. Verification of the model scheme is a way to determine the model's reliability. Then, variances in system parameters, boundary conditions, and initial conditions should be determined. Finally, variances in model results can be calculated. This verification procedure is illustrated using a simple example, namely the calculation of a freshwater-brackish interface in groundwater. (Author's abstract)
W83-03448

IMPROVED FORMULAS FOR ESTIMATING GROUNDWATER SUPPLIES BY SHORT-TERM PRECIPITATION-MINIMUM SERIES (VERBESSERTE ANSATZA FUER DIE SCHATZUNG DER DARGEBOTE VON GRUNDWASSERMENGEN DURCH NIEDERSCHLAGS-MINIMUM-KURZREIHEN),
For primary bibliographic entry see Field 2A.
W83-03461

GROUND WATER QUANTITY AND QUALITY IN FRACTURE ZONES IN ABBEVILLE COUNTY, SOUTH CAROLINA,
Clemson Univ., SC. Dept. of Chemistry and Geology.
For primary bibliographic entry see Field 3B.
W83-03466

TRANS-BOUNDARY GEOTHERMAL RESOURCES OF TEXAS AND MEXICO,
Texas Univ. at Austin. Bureau of Economic Geology.
C. D. Henry, and R. A. Morton.
Natural Resources Journal, Vol 22, No 4, p 973-989, October, 1982. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Geothermal resources, *Resources development, *Texas, *Mexico, *Water temperature, Natural resources, Temperature, Geothermal power, Electric power production, Wells, Hot springs, Warm springs, Flow rate, Chihuahua, Coahuila, Tamaulipas, Nuevo Leon.

Potential geothermal resources in the Texas-Mexico border region include the following: convective geothermal systems in Trans-Pecos Texas, Chihuahua, and Coahuila; and geopressured geothermal systems in South Texas, Tamaulipas, and Nuevo Leon. The convective geothermal systems are characterized by hot springs and shallow hot wells located along normal faults. The maximum temperature measured is 90C, while the maximum temperature estimated from chemical geothermometers is 160C. For the most part, temperatures are lower, and none of the water is hot enough to generate electricity. Most are too far from population centers to be used for heating or industrial purposes with the exception of the Hueco Tanks near El Paso and Juarez. Data on flow rate, depth, measured/calculated temperature, total dissolved solids, and chemical type are presented for hot springs and wells in the Rio Grande Area. Geopressured geothermal well test data are also presented. One well in Brazoria County, Texas, tested at rates up to 3500 cu m/day with only a minor pressure decline. (Small-FRC)
W83-03499

2G. Water In Soils

FIELD EVALUATION OF A WATER MANAGEMENT SIMULATION MODEL,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 4A.
W83-03238

ON THE ESIMATION OF THE ERROR OF SOIL MOISTURE MEASUREMENT BY MEANS OF A NEUTRON SCATTERING PROBE (ZUR ABSCHATZUNG DES FEHLERS DER BODENFEUCHTE-MESSUNG MIT EINER NEUTRONENSONDE),
Freiburg Univ. (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W83-03242

ON-SITE SEWAGE DISPOSAL: SITE SUITABILITY, SYSTEM SELECTION AND SOIL ABSORPTION AREA SIZING,
Pennsylvania State Univ., University Park. Coll. of Agriculture.
For primary bibliographic entry see Field 5D.
W83-03268

WATER QUALITY TRANSMISSION AND RUNOFF FROM EASILY CRUSTED ERODABLE SOILS AND MINE SPOILS. EFFECTS OF IN-SITU CROSSLINKABLE OIL TREATMENTS,
North Dakota State Univ., Fargo. Dept. of Chemistry.
For primary bibliographic entry see Field 4D.
W83-03269

EFFICIENT USE OF WATER FOR IRRIGATION IN THE UPPER MIDWEST,
Illinois Univ. at Urbana-Champaign. Water Resources Center.
For primary bibliographic entry see Field 6D.
W83-03282

A COMPUTER MODEL FOR PREDICTING THE IMPACT OF IRRIGATING WITH SALINE WATER ON SOILS AND RUNOFF WATER IN MISSOURI,
Missouri Univ.-Columbia. Dept. of Agronomy.
For primary bibliographic entry see Field 3C.
W83-03284

SURFACE IRRIGATION AS AFFECTED BY ASH FROM MOUNT ST. HELENS,
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W83-03285

MEASUREMENT OF ACTUAL TRANSPIRATION OF NATIVE GRASS STANDS AS A COMPONENT OF NEBRASKA SANDHILLS GROUNDWATER HYDROLOGY,
Nebraska Univ., Lincoln. School of Life Sciences.
For primary bibliographic entry see Field 2D.
W83-03312

UNDISTURBED CORE METHOD FOR DETERMINING AND EVALUATING THE HYDRAULIC CONDUCTIVITY OF UNSATURATED SEDIMENTS,
Illinois State Geological Survey Div., Champaign.
A. Elzeftawy, and K. Cartwright.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-221721, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center Research Report No 177, Univ. of Illinois, Urbana, April 1983. 53 p, 14 Fig, 6 Tab, 25 Ref, 2 Append. OWRT A-097-ILL(5), 14-34-0001-0115.

Descriptors: *Unsaturated hydraulic conductivity, Soil water, Matching factor, *Permeability, Groundwater, *Soil water potential, *Water retention, *Illinois, Waste disposal sites.

A new method was developed to predict the transport of moisture and contaminants in soils. Study results indicate that this method could help simplify evaluation of municipal and industrial waste disposal sites for their potential environmental impact. Saturated and unsaturated hydraulic conductivities of several Illinois soils, calculated on the basis of pore size distribution, were shown to predict reliably the experimentally measured laboratory values. For coarse-textured soil materials and materials with a relatively narrow range of pore size, only one matching factor was required to calculate the hydraulic conductivity-water content relation accurately enough for many purposes; however, for fine-textured soil materials iwth a wide range of pore size distribution, two or more matching factors at a water content in the 0.3 to 0.4 bar range may be needed to obtain a useful evaluation for the unsaturated hydraulic conductivity.
W83-03319

OBTAINING SOIL PHYSICAL FIELD DATA FOR SIMULATING SOIL MOISTURE REGIMES AND ASSOCIATED POTATO GROWTH,
Stichting voor Bodemkartering, Wageningen (Netherlands).Dept. of Applied Soil Physics.
C. Belmans, L. W. Dekker, and J. Bouma.
Agricultural Water Management, Vol 5, No 4, p 319-333, December, 1982. 7 Fig, 3 Tab, 38 Ref.

Descriptors: *Soil moisture, *Crop yield, *Soil properties, Moisture content, Permeability coefficient, Permeability, Soil permeability, Crop growth, *Potatoes, Sand, Loam, *The Netherlands, Model studies, Moisture profiles.

Monitoring was undertaken of soil moisture regimes under potatoes during two growing seasons in a sandy loam and a silty clay loam soil in the Netherlands. Validation of calculated moisture contents with the simulation model SWATRE was obtained from measured moisture contents. The study collected the following data for use in the model: hydraulic conductivity, moisture retention, rooting depth and soil cover data. Measured groundwater levels formed the lower boundary condition, and precipitation and potential evapotranspiration the upper boundary condition of the model flow system. Calculated moisture contents agreed well with the measured values, but only when in situ moisture retention curves were used in the study and when the effects of cracking in the silty clay loam soil were expressed by modifying the hydraulic conductivity function. The moisture supply capacity of the sandy loam soil was highest, particularly in the first growing season, and this was interpreted as a major reason for the corresponding higher yields. Simulation can be used for predicting the soil moisture supply capacity in the context of land evaluation when soil cover and rooting depth are standardized, for example by simulating growth of a grass crop. (Baker-FRC)
W83-03390

A METHOD FOR IMPROVING CHEAPLY THE TIME RESPONSE OF PRESSURE-TRANSDUCER TENSIOMETER SYSTEMS,
Rothamsted Experimental Station, Harpenden (England).Dept. of Physics.
For primary bibliographic entry see Field 7B.
W83-03409

2H. Lakes

WATER STORAGE CAPACITY OF NATURAL WETLAND DEPRESSIONS IN THE DEVILS LAKE BASIN OF NORTH DAKOTA,
Fish and Wildlife Service, Bismarck, ND.
A. P. Ludden, D. L. Frink, and D. H. Johnson.
Journal of Soil and Water Conservation, Vol 38, No 1, p 45-48, January-February, 1983. 3 Fig, 4 Tab, 12 Ref.

Descriptors: *Water storage, *Surface runoff, *Wetlands, Rainfall, Runoff, Devils Lake Basin, Water supply development, *North Dakota.

The Devils Lake Basin study was undertaken in 1976 in response to the conflict between wildlife and agricultural interests and to better understand the basin's hydrology. The primary goal of the study was to develop a plan for long-term management of water and related land resources in the basin. The scope of the study was limited to estimating the storage capacities of the depressions other than lakes in the Basin. Shallow natural depressions account for maximum water surface area of 164,000 hectares of drained and undrained wetlands. Their maximum storage capacity is 811,000 cubic dekameters. The wetland depressions retain about 143,000 cubic dekameters or 72% of the total runoff for a 2-year runoff and about 537,000 cubic dekameters of 41% of the runoff for a 100-year runoff. The average depth of the depressions during normal runoff years is relatively shallow. A 2-year runoff will result in an average depth of 20 centimeters. A 100-year runoff will result in an average depth of 47 centimeters. At maximum capacity the average depth of the natural depression was estimated at 53 centimeters. (Baker-FRC)
W83-03160

EVALUATING THE RELEASE OF SOLUBLE COMPONENTS FROM SEDIMENT,
Technion - Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 5B.
W83-03168

BUFFER CAPACITIES OF FRESH WATER LAKES SENSITIVE TO ACID RAIN DEPOSITION,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
S. D. Faust, and A. McIntosh.
Journal of Environmental Science and Health, Part A, Vol 18, No 1, p 155-161, 1983. 1 Fig, 1 Tab, 3 Ref.

Descriptors: *Acid rain, *Buffer capacity, *Alkalinity, Acidity, Bases, Carbonates, Bicarbonates, Hydrogen ion concentration, Chemical reactions, Lakes, Streams.

The Van Slyke definition of buffer capacity, the increment of a strong base or strong acid that causes an incremental change in the pH value of water, is better than total alkalinity for defining a water's resistance to acid rain. This Van Slyke value, designated by beta, shows a peak at pH 6.3 for the bicarbonate-carbonate pair, indicating that the effect of acid rain on the pH and alkalinity of natural waters is not deleterious until this peak is traversed. A beta value of zero indicates a dead water with no capacity to neutralize acid. The beta values, pH and total alkalinity of lakes, reservoirs, and streams in New Jersey are given. Data clearly show that pH and alkalinity alone cannot determine buffer capacity. For example, Fairview Lake (pH of 5.5 and alkalinity of 10.2 mg per liter) has a beta value 11 times that of Clyde Potts Reservoir (pH of 7.3, alkalinity of 8.1 mg per liter). (Cassar-FRC)
W83-03171

THE PHYTOPLANKTON ECOLOGY OF DEVILS LAKE,
North Dakota Univ., Grand Forks. Dept. of Biology.
C. M. Conway.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-212282, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, North Dakota State University, Fargo, January 1983. 163 p, 31 Fig, 27 Tab, 120 Ref. OWRT A-053-NDAK(1), 14-34-0001-7071.

Descriptors: *Phytoplankton, Water quality, *Drainage, Nutrients, Migratory birds, Anions, Cations, Trace elements, Biomass, *North Dakota, Devils Lake, Ecosystems.

Devils Lake is an inland aquatic ecosystem of glacial origin and represents the largest natural lake in North Dakota. The Devils Lake basin is a self-contained drainage system of 3604 mi super 2(9334.4 km super 2), which consists of nine small watersheds. This lake lies in the central flyway for migratory waterfowl and approximately 50% of the waterfowl production in North America occurs in the region. Recorded lake levels for the past century have fluctuated drastically with changing climatic conditions. This has resulted in extreme changes in salinity and water quality. In this study the following items were determined: (1) ambient concentrations of major anions, cation, and selected trace elements, (2) the composition and biomass of phytoplankton, (3) the algal growth potential and limiting nutrients, and (4) statistically significant interactions of nutrients and algal biomass, seasonally and spatially in the Devils Lake system: Big Coulee, Main Lake and East Bay.
W83-03180

IN SITU NITROGEN (C2H2) FIXATION IN LAKES OF SOUTHERM VICTORIA LAND, ANTARCTICA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
F. C. T. Allnutt, B. C. Parker, K. G. Seaburg, and G. M. Simmons, Jr.
Hydrobiological Bulletin, Vol 15, No 3, p 99-109, December, 1981. 2 Fig, 5 Tab, 24 Ref.

Descriptors: *Nitrogen fixation, *Algae, *Acetylene reduction, *Antarctica, Lakes, Cold regions, Cyanophyta, Bacteria, Littoral zone, Benthic environment, Ice cover, Iced lakes.

Nitrogen fixation as measured by acetylene reduction occurred in several habitats in and near several Antarctic lakes located in southern Victoria Land. Samples of algal mat and sediments were collected during the summers of 1977-78 and 1978-79 from Lakes Bonney, Brownworth, Chad, Fryxell, Miers, Vanda, and Hoare. Nitrogen fixation rates were highest (up to 3.359 n mol acetylene per day per mg C) in bluegreen algal mats located in high light intensity habitats such as ice-free moats and peripheral and outflow areas. The benthic mats under reduced light, such as under 5-6 m of permanent lake ice, showed no detectable nitrogenase activity. Nitrogen fixation potential was greatest in water with lower ammonium ion levels and in the presence of heterocystous bluegreen algae, Nostoc commune, Tolypothrix, and Calothrix. Since organic additions to the culture did not stimulate nitrogen fixation, the role of heterotrophic bacteria was insignificant. However, anaerobic nitrogen fixation for select oxygen-free habitats could not be completely ruled out. (Cassar-FRC)
W83-03203

MEROMIXIS IN AN EQUATORIAL AFRICAN SODA LAKE,
Duke Univ., Durham, NC. Dept. of Zoology.
S. MacIntyre, and J. M. Melack.
Limnology and Oceanography, Vol 24, No 4, p 595-609, July, 1982. 8 Fig, 6 Tab, 46 Ref.

Descriptors: *Lake morphometry, *Meromixis, Hydrobiology, *Chemical stratification, *Seasonal variation, *Chemocline, Rainfall, *Stability analysis, Lakes, Lake morphology, Limnology, Mixing, Stratification, Lake basins, Thermal stratification, Diurnal distribution, Mixolimnion, *Kenya, Lake Sonachi.

Lake Sonachi, a small volcanic crater lake in central Kenya, was chemically stratified on all of 17 sampling dates spanning 8 years. Values of chemical stability were low. Maintenance of meromixis was attributed to basin morphometry, the diurnal periodicity of the winds and of thermal stratification, biological decomposition and seasonal and annual changes in rainfall. Wind speeds were maximal when the lake was thermally stratified. Higher values of hydrogen sulfide, lower pH, soluble reactive phosphate, and ammonia in deeper waters suggest that biological processes contribute to meromixis. During 1971-1976, rainfall totaled less than average and chemical stability declined to 700 ergs/sq cm. When the lake was sampled after 2 years of above average and 1 year of average rainfall, stability had increased to 200,300 ergs/sq cm, and the conductivity and the volume of water below the chemocline had increased substantially. It was suggested that chemical stratification is enhanced by groundwaters that dissolve evaporites in the lake sediments and seep into the lake. (Geiger-FRC)
W83-03254

THE UPTAKE OF DISSOLVED NITROGENOUS NUTRIENTS BY LAKE KINNERET (ISRAEL) MICROPLANKTON,
Harvard Univ., Cambridge, MA. Museum of Comparative Zoology.
J. J. McCarthy, D. Wynne, and T. Berman.
Limnology and Oceanography, Vol 24, No 4, p 673-680, July, 1982. 5 Fig, 5 Tab, 34 Ref.

Descriptors: *Nutrients, *Plankton, *Lakes, *Nitrogen, *Nitrates, *Ammonia, *Ureas, Cycling nutrients, Phytoplankton, Nitrogen coompounds, Seasonal variation, Microorganisms, *Israel, Lake Kinneret.

The uptake rates of dissolved nitrogenous nutrients by the microplankton of Lake Kinneret, a warm monomictic lake in northern Israel, were examined over a two-year period. Nitrate was generally the most abundant nutrient, followed closely by ammonia and urea nitrogen in much lower concentrations. In the spring when Peridinium cinctum was dominant, nitrate dominated the total nitrogenous nutrients pool, but at all times phytoplankton showed preferential uptake of ammonia. Peridinium bloom periods were characterized by the highest specific uptake and transport rates for ammonia. Throughout the study period, turnover times ranged from 21 to over 7,000 hr for nitrate, from 1 to 630 hr for ammonia, and from 5 to over 560 hr for urea nitrogen. Midday uptake rates for nitrate, ammonia, and urea nitrogen were all higher under natural light than in darkness. Patterns of microplankton preferential usage for the dissolved nitrogenous nutrients of lake Kinneret were similar to those reported for Chesapeake Bay plankton. (Geiger-FRC)
W83-03260

DIEL CHANGES IN NUMBERS AND ACTIVITIES OF BACTERIOPLANKTON IN A RESERVOIR IN RELATION TO ALGAL PRODUCTION,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
V. Straskrabova, and J. Fuksa.
Limnology and Oceanography, Vol 24, No 4, p 660-672, July, 1982. 5 Fig, 5 Tab, 22 Ref.

Descriptors: *Growth kinetics, *Reservoirs, *Diurnal distribution, *Seasonal variation, *Aquatic bacteria, Surface water, Seasonal distribution, Bacterial analysis, Algal growth, Phytoplankton, Plankton, *Czechoslovakia, Slapy Reservoir.

The changes in bacterial numbers, relative growth rates, and glucose uptake were examined in the surface layer of Slapy Reservoir, Czechoslovakia, during several 24-hr observation periods at intervals of 3 or 6 hr and once daily at 4 to 6 week intervals from April to October. No diel periodicity was observed in microscopic and plate counts, but all other parameters studied displayed regular diel patterns. The range of diel variation increased with increasing algal production. The diurnal average relative growth rates, half-saturation constant plus original substrate concentration values, and turnover times were distinctly higher than nocturnal values. During periods of algal activity, characteristic diel changes were also noted in glucose uptake kinetics. In autumn samples, the diel changes in the bacterial net uptake rate of extracellular products were twice as high as the maximum glucose uptake rate. Diel variations were significantly lower than seasonal variations only for microscopic counts and maximum glucose net uptake rates. For other parameters, the diel and seasonal fluctuations were similar. (Geiger-FRC)
W83-03263

THE BIOTA OF OKLAHOMA SPRINGS: NATURAL BIOLOGICAL MONITORING OF GROUNDWATER QUALITY,
Oklahoma Univ., Kingston. Biological Station.
W. J. Matthews, J. J. Hoover, and W. B. Milstead.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222455, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Oklahoma State Univ., Stillwater, May 1983. 64 p, 2 Fig, 4 Tab, 17 Ref, 1 Append. OWRT A-099-OKLA(1), 14-34-0001-1138.

Descriptors: *Fish, *Invertebrates, *Springs, Aquatic insects, Benthic fauna, *Bioassay, *Bioindicators, Groundwater, Groundwater reservoirs, Fish populations, Spring water, Stream biota, Sunfish, Aquatic animals, Aquifers, Benthos, Groundwater pollution, *Oklahoma.

A survey of the fishes and invertebrates of 49 Oklahoma springs, including locations in all major aquifers, was carried out in 1981 and 1982, with each spring sampled in both years. The objective of the research was to determine if faunal similarity was sufficiently great across years that spring community composition would be useful in biological monitoring of groundwater quality. (1) The total invertebrate community of springs generally showed high variation between the two years, and thus if not likely to be useful in a biological monitoring design for Oklahoma groundwater. (2) In contrast to the total invertebrate community, certain common and widespread invertebrates showed high stability of occurrence between years, and may thus represent viable choices for biological monitoring of water quality in springs. Included as potentially useful are: flatworms (Dugesia), snails (Physa), and the amphipod Hyalella azteca and the isopod Lirceus. (3) Fish were present in 17 of the springs, and showed higher stability of occurrence between years than did the invertebrate community. (4) A combination of native fishes that are common in springs and the invertebrates noted in No 2 above, might form the basis for a comprehensive plan of biological monitoring of water quality in springs and related aquifers in Oklahoma.
W83-03347

EXPERIMENTAL AND ANALYTICAL STUDY OF HEAT TRANSFER AND MIXING IN THERMALLY STRATIFIED BUOYANT FLOWS,
Purdue Univ., Lafayette, IN. Heat Transfer Lab.
R. Viskanta, and M. Behnia.
International Journal of Heat Mass Transfer, Vol 25, No 6, 1982, p 847-861, 13 Fig, 33 Ref. OWRT B-077-IND(8).

Descriptors: *Thermal stratification, *Heat transfer, *Thermal radiation, *Convection, *Water cooling, *Mixing, Stratification, Destratification, Radiation, Cooling, Buoyancy.

Unsteady natural convection in a nonuniformly stratified, finite depth, layer of water heated from below was studied. Laboratory experiments were performed using a MachZehnder interferometer as a diagnostic tool for measuring temperature and a shadowgraph technique for flow visualization. A 1-dim. model in conjunction with a two-differential equation k-epilson turbulence model was used to predict the dynamics of the mixed layer which develops when the thermally stratified fluid is heated from below. Good agreement between data and predictions was obtained using the model. Unsteady natural convection heat transfer and mixing which occur when either a thermally stratified layer of liquid is cooled by air flow over the free surface or a layer of liquid is simultaneously heated by an external radiation source and cooled by air flow over the free surface or a layer of liquid is simultaneously heated by an external radiation source and cooled by air flow over the free surface was studied both experimentally and analytically. An unsteady 1-dim. model was developed for predicting the temperature structure in water irradiated by an external source and simultaneously cooled by air flow over the surface. Turbulent mixing was calculated using the k-epsilon model of turbulence. The results obtained show that deposition of radiation in water plays an important role on buoyancy and wind shear induced mixing processes in the surface layers during simultaneous heating by radiation and cooling by convection.
W83-03370

A SURVEY OF WATER TRANSPARENCY IN IOWA LAKES,
Iowa State Univ., Ames. Dept. of Animal Ecology.
For primary bibliographic entry see Field 5C.
W83-03371

CONTROL OF ALGAL DOMINANCE THROUGH CHANGES IN ZOOPLANKTON GRAZING, LAKE WASHINGTON: PHASE I,
Washington Univ., Seattle. Office of Public Archaeology.
For primary bibliographic entry see Field 5G.
W83-03467

BIOLOGICAL ROLE OF PERCH IN THE KREMENCHUG RESERVOIR,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
Y. B. Zubenko.
Hydrobiological Journal, Vol 18, No 1, p 44-49, 1982. 3 Fig, 24 Ref.

Descriptors: *Perch, *Predation, *Fish diets, Fish food, Kremebchug Reservoir, *USSR, Pike, Reservoirs, Aquatic habitats, Aquatic populations, Fish populations, Fisheries, Food habits.

The perch population in the Kremenchug Reservoir, USSR, decreased the numbers of trash fish and served as food for the valuable species, pike-perch and pike. At the same time, perch did not reduce numbers of juveniles of valuable fish (white bream, wild carp, blue bream, roach). These conclusions were reached after examination of stomach contents of 557 mature perch, 193 pike, and 667 pike-perch in March-November 1971-72. It was estimated that in 1971 the perch diet consisted of 77.9% trash fish, 3.2% commercial fish, and 18.9% invertebrates. In 1972 the perch diet was 84.1% trash fish, 8.7% commercial fish, and 7.2% invertebrates. Perch catches were 70 tons in 1971 and 230 tons in 1972. Assuming that 1/3 of perch present were caught, the stock of trash fish destroyed by the perch was about 930 tons in 1971 and 3300 tons in 1972. Perch comprised 63.2% by weight of the stomach contents of pike-perch and 60.0% of pike. Only 0.9% of the perch stomach contents were juveniles of commercially valuable species. (Cassar-FRC)
W83-03472

MATERIAL AND ENERGY BALANCE OF ORGANIC MATTER IN THE WATERS OF THE RYBINSK RESERVOIR AND LAKE BAIKAL,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
B. A. Skopintsev.
Hydrobiological Journal, Vol 18, No 1, p 84-91, 1982. 4 Tab, 37 Ref.

Descriptors: *Organic matter, *Energy, Lakes, Oligotrophic lakes, Mesotrophic lakes, Lake Baikal, Rybinsk Reservoir, *USSR, Humus, Mineralization, Phytoplankton, Nutrients, Nitrogen, Phosphorus.

Material and energy balances of organic matter in two different types of lakes were determined using the bichromate method. Data from 1965 was used to compute the balances for Rybinsk Reservoir, a 25.4 cu km mesotrophic body with largely allochthonous aquatic humus of bog-soil origin. Annual organic inputs into Rybinsk Reservoir were 480,000 tons (4.1 quadrillion kilocalories) and 180,000 tons (1.8 quadrillion kilocalories) of autochthonous matter. Outputs from loss over the dam and mineralization were 450,000 tons of allochthononous matter and 160,000 tons of autochthonous matter. Balances for oligotrophic Lake Baikal, 22,160 cu km in volume, were computed from several published sources. Annual allochthonous organic matter input to Baikal was 304,000 tons (2.6 quadrillion kilocalories) and 3,968,000 tons (40 quadrillion kilocalories) of autochthonous organic matter. Outputs of allochthonous matter via discharge from the Angara River were 74,000 tons; of autochthonous matter, 4,179,000 tons by mineralization and 126,000 tons by burial in bottom sediments. Residence time of organic matter in Baikal was estimated at 50 years. In Baikal the organic forms of nitrogen and phosphorus were dominant over the mineral forms. This observation, in addition to very low chromaticity, confirmed the dominance of the planktonogenic fraction in Baikal aquatic humus. In Rybinsk the energy of the allochthonous aquatic humus was rapidly utilized in the vegetative period, producing a high bacterial biomass and enriching the water with nutrients and trace elements. This was not observed to a great extent in Baikal. (Cassar-FRC)
W83-03478

ZOOBENTHOS OF LAKES OF BLACK SEA RESERVATION (PRESERVE),
Akademiya Nauk URSR, Kherson. Black Sea State Preserve.
V. A. Pupkov.
Hydrobiological Journal, Vol 18, No 1, p 30-36, 1982. 3 Fig, 6 Tab, 8 Ref.

Descriptors: *Saline lakes, *Benthic fauna, *Invertebrates, Lakes, Black Sea Preserve, *USSR, Kinburn Spit, Seasonal variation, Biomass, Mollusks, Crustaceans, Polychaetes, Oligochaetes, Midges, Aquatic insects.

The zoobenthos of 18 lakes in the Kinburn spit and adjacent territory, south and west of the Dnieper River and north and east of the Black Sea, was studied in 1976-78. These shallow lakes, maximum depths of 1.5-2 m, classified as oligohaline (< 5 o/oo salinity), mesohaline, and ultrahaline (> 18.9 o/oo salinity). The bottom fauna included 31 invertebrate species (8 mollusks, 12 crustaceans, 4 polychaetes, 1 oligochaete, 4 chironomids, and some insect larvae). Species diversity was greatest in waters of 15.7 to 18.9 o/oo salinity. Most of these lakes were periodically in communication with the sea during wind tides. Species diversity was lowest in lakes with salinity > 30 o/oo. Chironomids, oligochaetes, and mollusks were common in oligohaline lakes. Abundance (individuals per sq m) varied as follows: oligohaline lakes, 1140 in summer to 6295 in winter; mesohaline lakes, 4460 in winter to 11,080 in summer; ultrahaline lakes, 740 in winter to 9560 in summer. Biomass (g per sq m) varied in the same patterns from 12.1 to 23.7, 21.3 to 105.9, and 0.32 to 15.8 in the three types of lakes, respectively. Total mean annual benthic invertebrate productions (kg per ha) were: oligohaline lakes, 4906; mesohaline lakes, 4443; and ultrahaline lakes, 864. (Cassar-FRC)
W83-03479

2I. Water In Plants

EFFICIENCY OF WATER USE BY CROPS UNDER ALLELOPATHY STRESS,
South Dakota Univ., Vermillion. Dept. of Biology.
F. A. Einhellig.
Water Resources Institute Completion Report, South Dakota State Univ., Brookings, February 1983. 51 p, 2 Fig, 6 Tab, 33 Ref, 5 Append. OWRT B-061-SDAK(1), 14-34-0001-0248.

Descriptors: Moisture uptake, *Weeds, Crop response, *Grain sorghum, *Soybeans, *Plant growth inhibitors, *South Dakota, Metabolism, Allelopathic stress, Plant stress.

The objective of this research was to determine the effects of allelopathic stress on water metabolism and growth of grain sorghum and soybeans. Experiments demonstrated that ferulic and p-coumaric acid treatments that reduced seedling growth also caused partial stomatal closure and a marked decrease in water potential. Combinations of t-cinnamic, ferulic, p-coumaric and caffeic acids resulted in synergistic inhibition of sorghum germination and growth. Further analyses showed one cultivar of sunflower, Interstate 894, and velvetleaf, Kochia, cocklebur and Jerusalem artichoke were allelopathic. Amendments of 1 g aqueous fresh-shoot extract in 120 ml nutrient media resulted in growth reduction in test seedlings. Likewise, sorghum seedlings grown in soil amended with 1 g of dried-weed extract in 80 g soil were stunted, and soybeans were inhibited in soil-pots containing 2 g : 80 g soil. Cocklebur was the most toxic weed. Extract-and residue-mediated growth reductions were accompanied by an increase in diffusive leaf resistance and/or a decrease in water potential, demonstrating that the allelopathic extract and residue components had activity similar to phenolic acids. Thus, exposure to water-soluble allelochemicals results in water stress in crop seedling, limiting productivity. It is feasible to minimize allelopathic effects on crop water metabolism and the consequential yield loss through avoidance management strategies.
W83-03313

AUTOMATED STRAIN GAGE DENDROGRAPHY FOR IMPROVED WATER UTILIZATION IN PLANTS,
Iowa State Univ., Ames. Dept. of Engineering Science and Mechanics.
C. P. Burger, D. B. Johnson, R. B. Hall, and R. C. Shultz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224212, Price codes: A03 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute Completion Report No. 126, May 1983, 38 p, 19 Fig, 17 Ref. OWRT B-072-IA(4), 14-34-0001-8086.

Descriptors: *Water stress, *Transpiration, *Water utilization, *Dendrography, *Strain gages, Plant growth, Populus clone 5377, Soybeans, Crop yeilds, Automation, *Plant water balance.

A plant continually strives to maintain a balance between the water supply available to it and the evaporative demands made on it. The stem of the plant is an important link in this process. As the plant attempts to respond to changes in the balance between the supply and demand systems, the diameter of its stem varies continually; it contracts when water stress increases and expands when it decreases. If these small changes can be reliably measured, then the dynamic variations in stem size can be used as a measure of the water status of a plant with wide varying applications in the areas of

water management and research. This research developed a procedure whereby electrical resistance strain gages are used to continuously measure stem changes on plants. Experiments were conducted to relate such changes to plant water status and to investigate the influence of several parameters on the level of stress and also on the ways in which water stress affects the growth and the physiological responses of young trees of populus clone 5377 and of soybeans. The overall conclusion is that stem strains relate very closely to water stress and can be used to evaluate parameters for minimizing water needs and maximizing crop yields and water use efficiency.
W83-03372

2J. Erosion and Sedimentation

A STOCHASTIC MODEL FOR SUSPENDED SOLIDS SETTLING VELOCITY,
New Jersey Agricultural Experiment Station, New Brunswick.
C. G. Uchrin, and W. J. Weber, Jr.
Journal of Environmental Science and Health, Part A, Vol 18, No 1, p 103-124, 1983. 18 Fig, 12 Ref.

Descriptors: *Suspended solids, *Settling velocity, *Sedimentation rates, Clays, Model studies, Particulate matter, Suspended sediments, Flocculation, *Stochastic process.

A stochastic model for representing particle fall velocity distribution for suspended sediments was developed. Particle fall velocity was assumed to follow a log-normal distribution. Flocculation effects were accounted for by distribution parameters. The model allows use of steady state equations for quasi-time variable analyses. A 10 ft high, 5 inch deep column was used to empirically determine the fall velocity distribution parameters. Results of column settling tests with samples from several rivers and streams agreed well with predicted results. (Cassar-FRC)
W83-03158

MAIN RESULTS OF INVESTIGATING SILTATION OF THE RESERVOIR OF THE TEREBLYA-RIKA HYROELECTRIC STATION,
M. N. Bukhin, and I. I. Nazarov.
Hydrotechnical Construction, Vol 15, No 10, p 631-637, 1981-1982. 4 Fig, 2 Tab, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 10, p 47-50, October, 1981.

Descriptors: *Reservoir silting, *Silting, *Sediment transport, Tereblya-Rika Reservoir, *USSR, Mountains, Suspended sediments, Deposition, Carpathian Mountains.

The Tereblya-Rika hydrostation is the first and largest complex built in the mountain rivers of the Ukrainian Carpathians. This 5 km long, 300-400 m wide reservoir varies in depth from 1.5 m in the upper reach to 35.0 m at the dam. In the 24 years of its operation siltration has reduced its total storage volume by 9%, active storage by 4.6%, and dead storage by 25%. Although the mean annual siltration rate during the first 20 years was calculated by different investigators at 50,000-70,000 cu m, it increased to 205,000 cu m during 1975-79. This was caused by a lack of erosion control measures during construction in a basin draining into the river. Siltation was nonuniform. Deepest deposits (4-5 m) were in the widening part of the reservoir. Minimum deposition is in the bank zone, near the dam, and in the upper reach of the reservoir in the original river channel. Landslides and bank destruction account for < 2% of total siltation. (Cassar-FRC)
W83-03204

SEDIMENTOLOGIC STUDY OF THE MOUTH OF THE GABON RIVER ESTUARY (ETUDE SEDIMENTOLOGIQUE DE L'EMBOUCHURE DE L'ESTUAIRE DU GABON),
Omar Bongo Univ., Libreville (Gabon Republic). Dept. of Geology.
For primary bibliographic entry see Field 2L.
W83-03257

SURFACE IRRIGATION AS AFFECTED BY ASH FROM MOUNT ST. HELENS,
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
L. G. King, and D. A. Peterson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219998. Price codes: A06 in paper copy, A01 in microfiche. Water Reseach Center completion report, Washington State Univ., Pullman, November 1982. 97 p, 13 Fig, 25 Tab, 57 Ref, 2 Append. OWRT C-10112-V(1459)(1).

Descriptors: *Mount St. Helens, *Volcanic ash, Tephra, *Irrigation, Infiltration, Intake, Runoff, Irrigation efficiency, Furrow irrigation, Irrigation return flow, Sediment, Sediment basins, *Washington.

Field data (1979-1981), from a predominantly furrow-irrigated region in central Washington, are presented to evaluate the effect of Mount St. Helens ashfall from the May 18, 1980, eruption on several irrigation parameters. Volume balance relationships were used to determine furrow intake rates, runoff, and deep percolation losses for 175 sets of individual furrows over a range of field lenghts, slopes, stream sizes, and crop types. Irrigation return flow quality was also monitored, on both an individual-field and an area-wide basis, to delineate nutrient losses from this 800-hectare irrigated tract. Results indicate that no significant changes in furrow infiltration runoff rates were evident following incorporation of the 3 to 4 cm-thick ash layer. On an area-wide basis, the eruption also had a relatively short-lived impact on return flow quality, with increased sediment levels evident in tailwater return flows for only a 5-week period. Normalized sediment loss per volume of return flow leaving the study area was actually less, however, during the 1980 irrigation season than for either 1979 or 1981. Contributing factors were rapid incorporation of ash by cultivation, efficient entrapment of waterborne ash by relatively empty sediment basins, and better management of irrigation by area farmers.
W83-03285

EFFECT OF INCORPORATION OF FALL-APPLIED FERTILIZER ON RUNOFF LOSSES OF NUTRIENTS AND SOIL FROM SOYBEAN GROUND,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. L. Baker, and J. M. Laflen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220350, Price codes: A04 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute Completion Report No 123, Iowa State Univ., Ames, March 1983. 55 p, 6 Tab, 13 Ref, 1 Append. OWRT A-078-IA(1), 14-34-0001-0017.

Descriptors: *Nutrients, *Erosion, Runoff, *Conservation tillage, *Fertilization, Nitrogen, Phosphorus, Potassium, *Soybean residue, Nonpoint pollution sources, *Iowa.

Plot measurements of soil and nutrient runoff concentrations and losses were made for two simulated rains in the fall after soybean harvest and fertilization (N, P and K at 31, 35 and 80 kg/ha, respectively). The five treatments were: fertilizer surface-applied, no incorporation; fertilizer point-injected into the soil; fertilizer incorporated by chisel plowing; fertilizer incorporated by disking; and no fertilizer applied, no tillage. Chisel plowing reduced surface residue coverage from 82% (before tillage and the first rain) to 48%; disking reduced coverage to 31%. About half the residue buried by tillage was uncovered by the first rain. Sediment concentrations in runoff from the tillage plots were about three times higher than from the no-tillage plots. For rain 1 (111 mm), loosening the soil by tillage reduced runoff amounts, particularly from the chisel-plow treatment; for rain 2 (72 mm), runoff from the disked treatment was about three times that from the other treatments. Total soil loss from the disk treatment was 2.3 T/ha, which was at least three times higher than any other treatment. Concentrations of NH sub 4-N, P0 sub 4-P, and K runoff water and on sediment from treatments where fertilizer was incorporated by either point-injection or tillage were at the same levels as from the unfertilized treatment. Chemical concentrations from the surface-application-without-incorporation treatment were significantly higher than from all other treatments, particularly for the first rain (e.g., NH sub 4>0.9 mg/L, and K>18 mg/L). Total NH sub 4-N, P0 sub 4-P and K losses were also the greatest for the surface-application-without incorporation treatment, but were only 0.8, and 0.4 and 5.9 kg/ha, respectively.
W83-03298

EVALUATION AND MONITORING OF THE HYDROLOGIC IMPACT OF CABIN CREEK, B.C. COAL PIT MINING ON THE NORTH FORK OF THE FLATHEAD RIVER,
Montana Univ., Missoula. Dept. of Geology.
For primary bibliographic entry see Field 6G.
W83-03325

SOIL CONSERVATION AND THE REDUCTION OF EROSION AND SEDIMENTATION IN THE COON CREEK BASIN, WISCONSIN,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 4D.
W83-03356

DYNAMIC MODELLING OF SUSPENDED SEDIMENT TRANSPORT IN STREAMS AS A FUNCTION OF SEDIMENT SUPPLY,
Oregon State Univ., Corvallis. School of Forestry.
J. VanSickle, and R. L. Beschta.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224196, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-76, Oregon State University, Corvallis, May 1983. 37 p, 9 Fig, 1 Tab, 29 Ref, 4 Append. OWRT A-052-ORE(1), 14-34-0001-1139.

Descriptors: *Sediment transport, *Suspended load, *Suspended sediments, Sediment concentration, *Sediment discharge, *Sediment load, Watershed models, Hydrologic models, *Oregon, Flynn Creek, Huntington Creek.

Sediment supplies and stream discharge together determine the patterns, over time, of suspended sediment loads in small streams. Most of the uncertainty in empirical streamflow-sediment relationships can be attributed to changing supplies. Our transport model augments the commonly used power function relating suspended sediment concentration, C, to stream discharge, Q, by inclusion of a variable S representing sediment stored in the channel system. The resulting supply-based model was calibrated to concentration and streamflow time series data from four storm events in a small, forested watershed in coastal Oregon as well as to data from a controlled reservoir release in Utah, during which streamflow was held constant for an extended period. In all cases, the supply-based model followed observed concentration time series more accurately than did a transport model based on Q alone. We further enhanced performance of the supply-based model by distributing the total sediment supplies into several compartments which were accessed at different levels of stream discharge. Both the single-compartment and distributed-supply models demonstrate that a knowledge of sediment supplies can improve predictions of suspended sediment concentrations during storm runoff.
W83-03368

SEDIMENT DEPOSITION MODEL FOR RESERVOIRS BASED ON THE DOMINANT PHYSICAL PROCESSES,
Military Academy, West Point, NY. Science Research Lab.
T. L. Rice, and D. B. Simons.
Canadian Water Resources Journal, Vol 7, No 2, p 45-62, 1982. 3 Fig, 18 Ref.

Descriptors: *Model studies, *Reservoirs, *Sedimentation, Sediment transport, Erosion, Flood control, Irrigation, Planning, Maintenance, *Colorado, John Martin Reservoir.

A model is presented which forms the basis for reducing the present shortcomings found in current methods used to provide a reasonably accurate estimate of the losses of storage space within a reservoir. The general ideas behind the model are discussed along with the results of its application to John Martin Reservoir in southeast Colorado. The idea behind this model deviates from past general developments in that the physical processes found in the reservoir system are used as the basis for distributing sediment, rather than attempting to establish patterns based on distributions existing in similar reservoirs. These processes are fundamentally the same in each system. Thirteen separate processes which have a bearing on reservoir sedimentation have been identified and defined. Usable representations of the dominant processes of inflow, outflow, settling by size fraction, reservoir circulation, redistribution of deposited sediment, consolidation, density flows, and flocculation were created and integrated using a computer simulation based on the Fortran IV language. Processes neither considered significant in influencing the final sediment disposition nor included in the model development are backwater deposition, shore erosion, vegetation induced deposition, landslides, and wind deposition. Run-of-the-river, normally ponded, and semi-dry reservoirs can be modeled. This is the first general model that claims the capacity to model a semi-dry system. Application of the model to narrow reservoirs is not advised. (Baker-FRC)
W83-03417

A MODIFIED SEDIMENT TRANSPORT MODEL FOR NATURAL STREAMS,
Copenhagen Univ. (Denmark). Inst. of Geography.
T. Thomsen.
Nordic Hydrology, Vol 13, No 2, p 79-92, 1982. 5 Fig, 3 Tab, 20 Ref.

Descriptors: *Rivers, *Sediment transport, *Suspended solids, *Mathematical models, *Model studies, Natural streams, Velocity, Flow, Friction, Bed load, Sediment load, Mathematical equations, *Denmark.

In an earlier investigation of the behavior of tracer particles for determination of bed load transport in an alluvial stream, specific records were taken of the particle velocities in the upper bed layer. These data aroused the interest for more detailed investigations. The result of measuring surface particle velocities with radioactive tracers, performed in five West Jutland (Demark) localities with different hydraulic conditions in natural alluvial rivers, was used for determination of the relation: (migration velocity of the particle divided by the friction velocity due to skin friction times mean velocity flow times the relative density of the sediment grains) times the square root of the dimensionless bed shear due to skin friction divided by the critical dimensionless bed shear. The results obtained were inserted as the parameters of Engelund and Fredoe's sediment transport model from Fort Collins, Colorado. A good correlation was obtained between measured and calculated sediment transport rates. Future investigations aimed at improving the description of the transport expression and the effective mean fall velocity will improve the model; detailed in situ measurements of the total sediment transport in natural streams will offer a more qualified basis for model calibration. (Small-FRC)
W83-03494

2K. Chemical Processes

FORESTS, WETLANDS AND WATERFOWL POPULATIONS IN THE TURTLE MOUNTAINS OF NORTH DAKOTA AND MANITOBA,
North Dakota State Univ., Fargo. Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W83-03181

THE POTENTIAL FOR ACID PRECIPITATION DAMAGE TO LAKES OF THE SIERRA NEVADA, CALIFORNIA,
California Univ., Berkeley.
For primary bibliographic entry see Field 5B.
W83-03182

THE CHEMISTRY OF GEOTHERMAL WATERS IN ICELAND. I. CALCULATION OF AQUEOUS SPECIFICATION FROM 0 TO 370C,
Iceland Univ., Reykjavik. Science Inst.
S. Arnorsson, S. Sigurdsson, and H. Svavarsson.
Geochimica et Cosmochimica Acta, Vol 46, No 9, p 1513-1532, September, 1982. 5 Fig, 9 Tab, 51 Ref.

Descriptors: *Thermal springs, *Minerals, Chemical properties, *Computer programs, *Speciation, Geothermal studies, Geysers, Geochemistry, Hydrogen ion concentration, Equilibrium, *Iceland.

A computer program was developed to calculate the composition and aqueous speciation of geothermal reservoir waters in Iceland. The program is designed to calculate pH, oxidation-reduction potentials, and gas partial pressures, and is specifically designed to handle geochemical data from wet-steam wells, hot-water wells, and boiling hot springs, although it may be adapted for use on non-thermal waters. Solubility data for selected geothermal minerals are included in the program to facilitate the study of solution/mineral equilibra. The program is useful in investigating chemical changes in the water following boiling, variable degassing and cooling, and how these changes affect solution/mineral equilibria. (Geiger-FRC)
W83-03201

RADIOELEMENTS, RADIOGENIC HELIUM AND AGE RELATIONSHIPS FOR GROUNDWATERS FROM THE GRANITES AT STRIPA, SWEDEN,
Royal Military Coll. of Science, Shrivenham (England).
For primary bibliographic entry see Field 2F.
W83-03208

EXTREME FRACTIONATION OF U234/U238 AND TH230/U234 IN SPRING WATERS, SEDIMENTS, AND FOSSILS AT THE POMME DE TERRE VALLEY, SOUTHWESTERN MISSOURI,
Geological Survey, Denver, CO.
B. J. Szabo.
Geochimica et Cosmochimica Acta, Vol 46, No 9, p 1675-1679, September, 1982. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Radioisotopes, *Uranium radioisotopes, Groundwater, *Geochemistry, *Spring water, *Sediments, Connate water, *Isotope fractionation, Geology, Isotope studies, Isotope tracers, Bogs, *Missouri.

The U234/U238 activity ratio in presently discharging spring waters, sediments, and fossils at the Pomme de Terre Valley of southwestern Missouri was measured to study the long-term effect of the ascending U234-enriched water on its surrounding depositional environment. The activity ratios of U234/U238 in five springs range from 7.2 to 16 in water which has been discharged for at least the past 30,000 years. Isotopic fractionation as great as 1600% was found between U234 and U238 in spring water, sediment and fossil samples. Clay units overlying the spring bog sediments of Trolinger Spring were enriched by as much as 720% in Th230 relative to their parent U234. These findings suggest that both preferential displacement by alpha recoil ejection and preferential emplacement by recoiling and physical entrapment are significant processes that are taking place in the geologic environment. The anomalies in the U234/U238 ratio in deep water may serve as a useful tool in hydrologic studies in southern Missouri. (Geiger-FRC)
W83-03209

POST-MINING NEUTRALIZATION OF ACIDIC SURFACE MINE LAKES,
Southern Illinois Univ. at Edwardsville. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W83-03278

RADON-222 IN POTABLE WATER SUPPLIES IN MAINE: THE GEOLOGY, HYDROLOGY, PHYSICS AND HEALTH EFFECTS,
Maine Univ. at Orono. Land and Water Resources Center.
C. T. Hess, C. V. Weiffenbach, S. A. Norton, W. F. Brutsaert, and A. L. Hess.
In: Proceedings Second Special Symposium on Natural Radiation Environment, 1981, Bhabha Atomic Research Center, Bombay, India, 1983. p 216-220, 4 Fig, 10 Ref. OWRT B-017-ME(3).

Descriptors: Carcinogens, Geology, Granites, Radioisotopes, *Maine, *Radon-22, *Potable water, Water supply, Water wells, Water analysis, Groundwater, Public health, *Pollutant identification.

Two thousand water samples from public and private drilled wells have been analyzed for super 222 Rn using liquid scintillation counting. Three hundred and fifty of these wells have been characterized in terms of geology, hydrology, and water chemistry. Twenty homes have been examined for ambient air-borne super 222 Rn using a diffusion alpha detector. Radon in water ranges from 20 to 180,000 pCi/l. Granites yield highest levels (X = 22, 100 pCi/l) with considerable inter- and intra-variation. Meta-sedimentary rocks yield levels characteristic of the lithology for metamorphic grades ranging from chlorite to andalusite. Sillimanite (and above) grades yield higher 222 super Rn levels due to the intrusion of uranium-bearing pegmatites in these terranes. Public water supplies have super 222 Rn levels 1 to 2 orders of magnitude less than private drilled wells. Airborne super 222 Rn in homes ranges from 0.05 to 210 pCi/l. At the high end of this range dose rates exceed recommended industrial exposure. In some homes, only a small fraction of the total super 222 Rn is due to the water supply. Average super 222 Rn levels in domestic water supplies for 16 counties, calculated by a really averaging rock types and their associated super 222 Rn levels, correlate with total cancers, especially lung and reproductive cancers.
W83-03308

THE ROLE OF FULVIC SUBSTANCES ON TRACE METAL PARTITIONING IN NATURAL AQUATIC SEDIMENTS,
Massachusetts Univ., Amherst. Dept. of Chemistry.
O. T. Zajicek.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222844, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 140, Massachusetts University, Amherst, May 1983. 38 p, 13 Fig, 2 Tab, 12 Ref. OWRT A-127-MASS(1), 14-34-0001-0123.

Descriptors: *Hydrogen ion concentrations, Solubility, *Fulvic acids, Sediments, *Metals, *Carbonates, Carbonate rocks, *Soil chemical properties, Aquatic soils, Adsorption, Acidity, Alkalinity, Chemical precipitation, *Potentiometers, Cadmium, Copper, Iron, Manganese, Zinc, Oxides, Silica, Titration, *Volumetric analysis.

The effect of fulvic acids (1) on the solubility of the metal carbonates of copper, cadmium, manganese, and zinc, (2) on the adsorption properties of silica and pyrolusite, and (3) on the acid attack on ferric orthophate were investigated by means of distribution and potentiometric measurements. Metal carbonates were found to increase in solubility in waters containing fulvic acids proportional to the fulvic acid concentration. Metal concentrations obtained exceeded acceptable limits for aquatic systems. Metal ion adsorption on Si0 sub 2 and Mn0 sub 2 was essentially unaffected by pH over range 5-9. The addition of fulvic acids resulted in the desorption of the majority of the metal from Si0 sub 2, and to a much lesser extent, Mn0 sub 2. Ferric orthophosphate, FeP0 sub 4, was found to form in solutions of low pH. Formation of ferric oxide occurred at higher pH values than usual in the presence of phosphate and fulvic acids.

The fulvic acids appear to enhance solubilization processes by complexation of metal ions in solution. They aid or hinder the adsorption of metals on hydrous metal oxides, depending upon the relationship between the pH and the point of zero charge of the oxide substrate. Adsorption on silica is markedly affected by fulvic acids, and that on pyrolusite by both fulvic acids and pH.
W83-03348

METHODOLOGIES FOR EXTRACTION OF DISSOLVED INORGANIC CARBON FOR STABLE CARBON ISOTOPE STUDIES: EVALUATION AND ALTERNATIVES,
Geological Survey, Reston, VA. Water Resources Div.
A. A. Hassan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-257288, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-6, 1982. 51 p, 6 Fig, 8 Tab, 24 Ref.

Descriptors: *Stable isotopes, *Carbon radioisotopes, *Isotope studies, *Separation techniques, Water analysis, Chemical precipitation, Computers, Simulation analysis, *Gas evolution techniques, *Dissolved inorganic carbon.

The gas evolution and the strontium carbonate precipitation techniques to extract dissolved inorganic carbon (DIC) for stable carbon isotope analysis were investigated. Theoretical considerations, involving thermodynamic calculations and computer simulation pointed out several possible sources of error in delta carbon-13 measurements of the DIC and demonstrated the need for experimental evaluation of the magnitude of the error. An alternative analytical technique, equilibration with out-gassed vapor phase, is proposed. The experimental studies revealed that delta carbon-13 of the DIC extracted from a 0.01 molar NaHC03 solution by both techniques agreed within 0.1 per mil with the delta carbon-13 of the DIC extracted by the precipitation technique, and an increase of only 0.27 per mil in that extracted by the gas evolution technique. The efficiency of extraction of DIC decreased with sulfate concentration in the precipitation technique but was independent of sulfate concentration in the gas evolution technique. Both the precipitation and gas evolution technique were found to be satisfactory for extraction of DIC from different kinds of natural water for stable carbon isotope analysis, provided appropriate precautions are observed in handling the samples. For example, it was found that diffusion of atmospheric carbon dioxide does alter the delta carbon-13 of the samples contained in polyethylene bottles; filtration and drying in the air change the delta carbon-13 of the samples contained in polyethylene bottles; filtration and drying in the air change the delta carbon-13 of the precipitation technique; hot manganese dioxide purification changes the delta carbon-13 of carbon dioxide. (USGS)
W83-03359

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-5A, H-5B, AND H-5C, AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
K. F. Dennehy, and J. W. Mercer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-263641, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-19, February 1982. 83 p, 18 Fig, 5 Tab, 6 Ref.

Descriptors: *Radioactive waste disposal, *Underground waste disposal, *Geohydrology, *Hydrologic data, Aquifer characteristics, Transmissivity, Storage coefficients, Water quality control, Test wells, Pumping tests, Water sampling, *New Mexico, Waste Isolation Pilot Plant.

Data were collected during hydrologic testing at wells H-5A, H-5B, and H-5C in the northeastern part of the proposed Waste Isolation Pilot Plant site in southeastern New Mexico. The three water-bearing zones tested, the Magenta and Culebra Dolomite Members of the Rustler Formation and the Rustler Formation-Salado Formation contact, yield water to wells at rates less than 0.6 gallon per minute. Throughout the testing, water-pressure response in the tested zone was monitored by a pressure-transducer system. Shut-in and slug tests were conducted to acquire data. Water samples from the Magenta Dolomite Member, Culebra Dolomite Member, and Rustler Formation-Salado Formation contact had dissolved-solids concentrations of 6,090, 144,000, and 412,000 milligrams per liter, respectively. The major chemical constituents of water samples from the Magenta Dolomite Member were sodium and sulfate; from the Culebra Dolomite Member, sodium and chloride; and from the Rustler Formation-Salado Formation contact, magnesium, and chloride. Radium-226, a naturally occurring radioactive element, was present in samples from all three zones. (USGS)
W83-03360

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-6A, H-6B, AND H-6C, AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
K. F. Dennehy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-104042, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-8, January 1982. 68 p, 13 Fig, 5 Tab, 7 Ref.

Descriptors: *Radioactive waste disposal, *Underground waste disposal, *Geohydrology, *Hydrologic data, Aquifer characteristics, Transmissivity, Storage coefficient, Water quality control, Test wells, Pumping tests, Water sampling, *New Mexico, Waste Isolation Pilot Plant.

Hydrologic testing was conducted at 3 test wells in the northwestern part of the proposed Waste Isolation Pilot Plant site in southeastern New Mexico to define hydraulic properties of three water-bearing zones. The zones tested were the Magenta and Culebra Dolomite Members of the Rustler Formation and the Rustler Formation-Salado contact. The Rustler Formation and the contact yield water to wells at rates less than 0.5 gallon per minute as determined from shut-in and slug tests. These test methods were not applicable for the Culebra Dolomite Member of the Rustler Formation at well H-6B. A transmissivity value for the Culebra Dolomite Member was obtained by conducting a conventional pumping test. Well H-6B was pumped at a rate of approximately 11 gallons per minute. Throughout the testing of the Magenta Dolomite Member and the Rustler Salado contact, water-pressure response in the test zones were monitored by a pressure transducer system. Water samples from the Magenta Dolomite Member had a dissolved solids concentration of 5,760 milligrams per liter. The major chemical constituents of water samples from this zone were sulfate, sodium, and chloride. Water samples from the Culebra Dolomite Member and the Rustler-Salado contact had dissolved-solids concentrations of 52,600 and 316,000 milligrams per liter, respectively; chloride and sodium were the major constituents in the water samples. Radium-266, a naturally occurring radioactive element, was present in samples from all three zones. (USGS)
W83-03361

ENVIRONMENTAL ISOTOPIC AND HYDROGEOCHEMICAL INVESTIGATION OF RECHARGE AND SUBSURFACE FLOW IN EAGLE VALLEY, NEVADA,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 2F.
W83-03380

EFFECTS OF COAL BURNING IN NEW MEXICO ON AIR QUALITY AND SURFACE WATER QUALITY: RATON STUDY AREA,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Chemistry.
C. J. Popp, R. W. Ohline, D. K. Brandvold, and L. A. Brandvold.
New Mexico Water Resources Research Institute Report No 157, Las Cruces, November 1982. 55 p, 7 Fig, 16 Tab, 32 Ref.

Descriptors: *Powerplants, *Water quality, *Surface water, *Acid rain, *Heavy metals, Coal, Trace elements, Precipitation, Particulate matter, Particle shape, Aerosols, Air pollution, Environmental effects, Small watersheds, Model studies, *New Mexico, Raton.

Acid precipitation has not been documented adequately in the Southwest and preliminary data indicate it may be a problem. The potential long-term effects on surface water and air quality were studied at this small power generating facility. The results may allow comparison for modeling to larger power plants. Coal combustion produces particulate matter that includes heavy metals and volatile, adsorbed trace metals, such as arsenic, cadmium, copper, lead, selenium and zinc. The particles may travel great distances before settling out or coming down with precipitation. Many of the precipitation samples were more acidic than predicted simply from carbon dioxide equilibrium, and the weighted average pH was 4.9 for wet-only precipitation. The deposited fly ash often has some elements in soluble form that could be concentrated on watersheds and ultimately further concentrated in bodies of water and biomagnified in aquatic life. Surface water samples in the Raton area seem to have normal trace metal content when compared to the Rio Grande in New Mexico. However, because some metals can be leached from fly ash by water, the ash should not be exposed to surface or groundwater supplies. A long-term extensive monitoring system for precipitation should be established and research efforts increased to identify the sources of the acid-causing material. Release of fly ash to the environment should be kept as minimal as possible, although no adverse environmental effects were noted in the study area. (Atkins-Omniplan)
W83-03382

'GEOTHERMAL MINERAL EQUILIBRIA.' REPLY TO A COMMENT BY M. A. GRANT,
Department of Scientific and Industrial Research, Petone (New Zealand). Chemistry Div.
W. F. Giggenbach.
Geochimica et Cosmochimica Acta, Vol 46, No 12, p 2681-2683, December, 1982. 1 Fig, 5 Ref.

Descriptors: *Geothermal studies, *Mineral water, Chemical reactions, Groundwater, Equilibrium, Temperature, Carbon dioxide, Partial pressure.

The author replies to a comment on 'Geothermal mineral equilibria.' The original paper was published in Geochimica et Cosmochimica Acta, Volume 45, pages 393-410, 1981, and the comment in Volume 46, pages 2677-2680, 1982. He states that the dominant process limiting carbon dioxide contents of high temperature geothermal fluids is the conversion of primary plagioclase by C02 to calcite and clay according to the equation described in the original paper. Errors in partial pressure of C02 can be produced by variations in activities of the anorthite and kaolinite components of the mineral phases. At lower temperatures the variations of C02 partial pressures are caused by secondary processes such as adiabatic expansion, conductive cooling, and mixing with cooler groundwaters. (Cassar-FRC)
W83-03416

ON THE LACK OF A UNIQUE RELATION BETWEEN C02 PARTIAL PRESSURE AND TEMPERATURE IN GEOTHERMAL SYSTEM. COMMENT ON 'GEOTHERMAL MINERAL EQUILIBRIA' BY W. F. GIGGENBACH,
Department of Scientific and Industrial Research, Wellington (New Zealand). Applied Mathematics Div.
M. A. Grant.
Geochimica et Cosmoschimica Acta, Vol 46, No 12, p 2677-2680, December, 1982. 2 Fig, 1 Tab, 31 Ref.

Descriptors: *Geothermal studies, *Mineral water, Carbon dioxide, Partial pressure, Temperature, Chemical reactions, Equilibrium, Groundwater.

A comment on 'Geothermal mineral equilibria,' published in Geochimica et Cosmochimica Acta, Volume 45, pages 393-410, 1981, states that a proposed equation relating temperature and carbon dioxide partial pressure in deep liquid in geothermal systems is not valid. The proposed relation is: log of the partial pressure of C02 = A - B/(t + 273), where A = 15.26 and B = 7850. Both high and low C02 partial pressures occur at both high and low geothermal temperatures. The mineral equilibria present are not significant compared to other effects. Within each field there is usually a correlation between gas content and temperature, reflecting adiabatic expansion of the deep liquid, which has a composition peculiar to the specific geothermal field. Giggenbach's data are not suitable because of adiabatic expansion, changes due to exploitation, and problems in data selection. (Cassar-FRC)
W83-03434

TRANS-BOUNDARY GEOTHERMAL RESOURCES OF TEXAS AND MEXICO,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 2F.
W83-03499

2L. Estuaries

WATER MIXING IN A TIDAL CURRENT AND THE EFFECT OF TURBULENCE ON TIDAL EXCHANGE THROUGH A STRAIT,
Kyoto Univ. (Japan). Geophysical Inst.
T. Awaji.
Journal of Physical Oceanography, Vol 12, No 6, p 501-514, June, 1982. 10 Fig, 15 Ref.

Descriptors: *Tidal currents, *Tidal effects, *Turbulent flow, *Mixing, *Straits, Flow, Tides, Stokes law, Water currents, Ocean circulation, *Japan, Estuarine environment.

Water particles released in a turbulent tidal current were numerically tracked, and the physical manner of the Lagrangian movement of particles was investigated to understand local mixing of water. The mechanism of tidal mixing in the inner and outer waters divided initially by a strait was investigated during three cylcles of the M2 tide with and without turbulence. In the vicinity of the strait, turbulence strongly affected the Lagrangian movement. This, in combination with a large Stokes drift, caused mixing of the particles initially adjacent. Turbulence had a minor influence on the water volume exchanged through the strait, but did greatly affect the area of the sea influenced by the tidal exchange. The dispersion coefficient determined from particle spread reached 8 times 10 to the 6th cm sq/sec in the vicinity of the strait. (Small-FRC)
W83-03159

THE ROLE OF DELAWARE RIVER FRESHWATER TIDAL WETLANDS IN THE RETENTION OF NUTRIENTS AND HEAVY METALS,
Rider Coll., Lawrenceville, NJ. Dept. of Biology.
R. L. Simpson, R. E. Good, R. Walker, and B. R. Frasco.
Journal of Environmental Quality, Vol 12, No 1, p 41-48, January/March, 1983. 2 Fig, 7 Tab, 40 Ref.

Descriptors: *Marshes, *Metals, *Nutrients, Fate of pollutants, Delaware River, Estuaries, Tidal marshes, Heavy metals, Phosphorus, Nitrogen, Wetlands, *New Jersey, Litter, Nonpoint pollution sources, Vegetation, Macrophytes, Aquatic plants, Accumulation, Bioaccumulation.

Nutrient and heavy metal budgets were determined for two New Jersey marshes in the Delaware Estuary in 1979. Nitrate was imported into the marshes in June, July, and November and exported in August and September. Nitrites and ammonium were imported in June, July, and August and exported in September and November. Organic N was imported in August and November and exported in September. Reactive phosphorus was imported in July, September, and November and exported in August. Total P was imported in July, August, and November and exported in June and September. Cd was always exported from the marsh. Cu, Ni, and Zn were imported except for 1 date each. Pb was imported in August-November and exported in June and July. Vegetation played a major role in retention of N, P, Cu, Pb, and Ni entering the marsh; concentrations of heavy metals in vegetation were higher in September than earlier in the growing season. Litter retained significant amounts of all heavy metals (1.5-4 times that in September vegetation) and nutients after macrophyte dieback. Nutrient and heavy metals levels in soil showed no seasonal patterns. (Cassar-FRC)
W83-03169

A SEASONAL STUDY OF THE DISTRIBUTIONS OF SURFACE STATE VARIABLES IN LIVERPOOL BAY. III. AN OFFSHORE FRONT,
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
P. Foster, D. Voltolina, C. P. Spencer, I. Miller, and J. Beardall.
Journal of Experimental Marine Biology and Ecology, Vol 58, No 1, p 19-31, 1982. 7 Fig, 2 Tab, 13 Ref.

Descriptors: *Nutrients, *Salinity, *Phytoplankton, Estuarine environment, Liverpool Bay, Bays, Temperature, Water temperature, Coastal waters, Silicates, Nitrates, Fate of pollutants, Rivers, *England.

The presence of an intense density discontinuity running north-south was confirmed in Liverpool Bay during the winter of 1976-77. Consideration of salinity, temperature, and dissolved nutrients indicated a sharp line of demarcation between offshore and coastal waters. By March river discharge had accumulated near shore, producing a region of distinctly lower salinity and temperature, higher dissolved inorganic nutrients, and lower Si to total N ratios than offshore waters. In March the differences between offshore and inshore waters were 0.7C, 1.19 o/oo salinity, 219 micrograms nitrate-N per liter, and 184 micrograms Si per liter. These differences are related to the population dynamics of the phytoplankton. For example, the low silicate levels in inshore waters can be limiting to diatoms, and the low nitrate levels in offshore waters will be limiting to other organisms. (Cassar-FRC)
W83-03173

FORESTS, WETLANDS AND WATERFOWL POPULATIONS IN THE TURTLE MOUNTAINS OF NORTH DAKOTA AND MANITOBA,
North Dakota State Univ., Fargo. Dept. of Zoology.
R. E. Stewart, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-212290, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, North Dakota State University, Fargo, January 1983. 196 p, 12 Fig, 45 Tab, 144 Ref. OWRT A-028-NDAK(1), 14-34-0001-3234.

Descriptors: *Waterfowl, *Wetlands, *Trees, Habitat, Shrubs, Water chemistry, Mallard duck, Canvasback duck, Blue-winged teal, Ring-necked duck, Shallow water, Terrestrial habitats, Freshwater marshes, Aspen trees, Oak trees, Elm trees, Ash trees, *North Dakota, *Manitoba, *Waterfowl.

The Turtle Mountains are an international aspen island in a sea of prairie Forests, wetlands and waterfowl of the Turtle Mountains were studied from 1967 through 1970. The orographic effect of the low escarpment may be ten inches of precipitation. The Manitoba portion is a virtual wilderness, while the North Dakota side is heavily farmed. Tax record analysis of land-use of the U.S. side indicates 45% of the land area was still forested in 1967; only 30% was ungrazed woodland. Class 3 to 5 wetlands (seasonal, semi-permanent and permanent) and waterfowl were studied on 80 quarter sections of land, 60 on the U.S. side from 1967-1970, and 20 on the Canadian portion from 1969-1970. A severe drought that persisted from summer 1967 to summer 1968 reduced total wetland acreage by 20%. Class 3 and 4 wetlands were reduced by 73 and 50%, respectively. Wetlands on the Canadian side tend to be more numerous per unit area, larger and have longer shore lines than wetlands on the U.S. portion. The number of Class 3 to 5 wetlands in the Turtle Mountains is estimated at 12,121 with 93,968 acres. Water chemistry determinations indicated wetlands had an average pH of 8.0 average alkalinity of 280 mg/L CaC0 sub 3 and an average specific conductance of 630 mmhos/cm super 3. Fifteen species of waterfowl were encountered during breeding pair and brood surveys. Statistical estimates of pair, brood and young density per section were made along with Highest Probability Density estimates of their precision, employing the Bayesian philosophy of statistics. On the average the U.S. side produced 95 pounds of young duck per section while the Canadian portion produced 185 pounds.
W83-03181

PRODUCTION OF INVERTEBRATES IN THE TIDEWATER ZONE OF A COASTAL RIVER AND ADJACENT ESTUARY,
Georgia Univ., Savannah. Marine Extension Service.
D. M. Gillespie, and J. C. Hodges, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-214932, Price codes; A04 in paper copy, A01 in microfiche. Environmental Resources Center Report No ERC 04-82, Georgia Institute of Technology, Atlanta, November 1982. 57 p, 5 Fig, 14 Tab, 30 Ref, 1 Append. OWRT A-065-GA(1), 14-34-0001-5010.

Descriptors: *Benthos, Coastal rivers, Currents, *Estuaries, *Estuarine environment, Euryhaline marine forms, Oligohaline upper reaches, Riverine species, Reversing currents, *Secondary productivity, Tidewater channels, *Georgia, Satilla River, St. Andrews Sound estuary.

The tidewater area of the Satilla River, and the adjacent St. Andrews Sound estuary were sampled to determine the distribution and production of estuarine invertebrates. Sampling in the Satilla tidewater area was carried out from December 1975 through November 1976, and included sand and mud benthos samples and plankton tows. Sampling in St. Andrews Sound extended from September 1976 through August 1977, and was restricted to benthos. Invertebrate distributions were analyzed and showed a predicted pattern of abundance, with euryhaline marine forms near the mouth of the estuary, estuarine forms dominating the brackish area and a few freshwater forms penetrating oligohaline upper reaches. Species diversity, density and biomass all appeared to be severly reduced in the tidewater area as compared to the sound and the non-tidal part of the river. Productivity in St. Andrews Sound was very high, and was dominated by sand-dwelling amphipods. Productivity of the non-tidal Satilla River, as determined in another study was also very high, but the tidewater zone of the river showed very depressed benthic productivity, although plankton production was moderate. The low diversity of such estuarine areas has been frequently found in other studies and was not surprising. The low biomass and productivity were, on the other hand, counter to conventional ecological wisdom, and were unexpected. In attempting to account for these results, it was found that the tidewater area is very unpredictable with regard to salinity as a result of rapid, irregular fluctuations in river discharge. It was also found that fauna in the freshwater tidal area were primarily riverine species adapted to consistent currents, and may be stressed by the reversible current in the tidewater channel. It is hypothesized that extremely low environmental predictability may be a factor in a reduced productivity, and also that production of riverine species may be restricted in tidal channels with reversing current. The low production in tidewater channels, if confirmed, is an indication of the stress under which biological communities in these areas exist.

We advise careful consideration before subjecting such stressed communities to additional impacts. W83-03183

COMPOSITION OF ESTUARINE COLLOIDAL MATERIAL: ORGANIC COMPONENTS,
Geological Survey, Reston, VA.
A. C. Sigleo, T. C. Hoering, and G. R. Helz.
Geochimica et Cosmochimica Acta, Vol 46, No 9, p 1619-1626, September, 1982. 4 Fig, 1 Tab, 42 Ref.

Descriptors: *Estuaries, *Colloids, *Organic matter, Rivers, *Chemical composition, *Polymers, Detritus, Microorganisms, Carbohydrates, Peptides, Proteins, Hydrocarbons, Phytoplankton, *Maryland, Patuxent River, Chesapeake Bay.

Colloidal material in the size range 1.2 nanometers to 0.4 micrometers was isolated by ultrafiltration from Chesapeake Bay and Patuxent River waters. Temperature controlled, stepwise pyrolysis of the freeze-dried material, followed by gas chromatographic-mass spectrometric analyses of the volatile products, indicates that the primary organic components of this polymer are carbohydrates and peptides. The major pyrolysis products at the 450 degrees step are acetic acid, furaldehydes, furoic acid, furanmethanol, diones and lactones characteristic of carbohydrate thermal decomposition. Pyrroles, pyridines, amides and indole (protein derivatives) become more prevalent and dominate the product yield at the 600 degrees pyrolysis step. Olefins and saturated hydrocarbons, originating from fatty acids, are present only in minor amounts. These results are consistent with the composition of Chesapeake phytoplankton (approximately 50% protein, 30% carbohydrate, 10% lipid and 10% nucleotides by dry weight). The pyrolysis of a cultured phytoplankton and natural particulate samples produced similar oxygen and nitrogen-containing compounds, although the proportions of some components differ relative to the colloidal fraction. There were no lignin derivatives indicative of terrestrial plant detritus in any of these samples. The data suggest that aquatic microorganisms, rather than terrestrial plants, are the dominant source of colloidal organic material in these river and estuarine surface waters. (Author's abstract)
W83-03202

SEDIMENTOLOGIC STUDY OF THE MOUTH OF THE GABON RIVER ESTUARY (ETUDE SEDIMENTOLOGIQUE DE L'EMBOUCHURE DE L'ESTUAIRE DU GABON),
Omar Bongo Univ., Libreville (Gabon Republic). Dept. of Geology.
P. Weydert, and O. Weydert.
Marine Geology, Vol 49, p 1-22, 1982. 14 Fig, 3 Tab, 25 Ref. English summary.

Descriptors: *Estuaries, *Tidal currents, *Navigable rivers, *Sedimentation, *Deposition, Tides, Tidal effects, Navigation, Sediments, Mud, Mud flats, Sand, Alluvium, Gabon River estuary, *Gabon.

Results of a study of the character and distribution of sediments at the mouth of the Gabon River estuary are presented. The Gabon is on the west coast of Africa. The mouth of the estuary comprises three sectors: 1) a wide and deep navigation channel containing fine, well-sorted sands due to the presence of strong tidal currents; 2) a broad shelf covered with muddy sands, due to tidal drainage from nearby mangrove swamps (this sector features large sand banks, weaker currents, and high turbidity); and 3) a hard ground in the middle of the estuary with biodetrital deposits. Based on these findings, a hypothesis regarding the navigation channel is presented. It is suspected that strong currents are promoting erosion of the bank, causing a shift away from the original alignment of the channel with the original river course. (Titus-FRC)
W83-03257

PARTICULATE MATTER RESUSPENSION VIA METABOLICALLY PRODUCED GAS BUBBLES FROM BENTHIC ESTUARINE MICROALGAE COMMUNITIES,
Florida Dept. of Natural Resources, St. Petersburg. Marine Research Lab.
M. J. Durako, R. A. Medlyn, and M. D. Moffler.
Limnology and Oceanography, Vol 24, No 4, p 752-756, July, 1982. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Estuaries, *Particulate matter, *Benthos, *Cycling nutrients, *Kinetics, *Suspended sediments, Nutrients, Algae, Benthic flora, Detritus, Marine sediments, *Florida, Tampa Bay, *Gas bubbles.

Cultures of Thalassia testudinum in the laboratory were observed to carry particulate matter to the water surface via metabolically produced gas bubbles originating from the sediments. The bubbles were assoicated with microalgae in the benthos, and particulate matter was resuspended after the bubbles burst after a few minutes. Gas bubble evolution and suspension of particulates were examined in gas/sediment traps in the laboratory. After a 24 hr-period, 307.9 milliliters of gas were evolved and 0.97 grams (dry weight) of particulate matter were resuspended under laboratory conditions. In situ studies in Tampa Bay, Florida yielded similar values for gas production, but showed higher loads of resuspended particulate. Chromatographic analyses of bubbles showed that the major component was photosynthetically produced oxygen. The resuspended particulate matter was 70-96% inorganic; the organic fraction was made up of detrital matter and living organisms. These findings may be important in studying the sediment kinetics and nutrient cycles of estuarine systems. (Geiger-FRC)
W83-03261

CHESAPEAKE BAY NUTRIENT AND PLANKTON DYNAMICS. 1. BACTERIAL BIOMASS AND PRODUCTION DURING SPRING TIDAL DESTRATIFICATION IN THE YORK RIVER, VIRGINIA, ESTUARY,
Lamont-Doherty Geological Observatory, Palisades, NY.
H. W. Ducklow.
Limnology and Oceanography, Vol 24, No 4, p 651-659, July, 1982. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Estuaries, *Destratification, *Mixing, *Nutrients, *Marine bacteria, *Biomass, *Tidal effects, Stratification, Chemical stratification, Salinity, Carbon, Aquatic productivity, Phytoplankton, *Virginia, York River estuary, Chesapeake Bay.

Bacterial abundance, biomass, and tritiated-thymidine incorporation rates were studied during spring tidal destratification of the York River, Virginia, estuary during August-September 1980. Monthly high spring tides caused salinity destratification in the moderately stratified estuary, which oscillates between stratified and vertically homogeneous conditions on a 1-10 day cycle. Bacterial abundance ranged from one billion to 8 billion cells/liter, and carbon biomass ranged from 20 to 100 micrograms/liter. Thymidine incorporation into cold trichloroacetic acid-insoluble fractions ranged from 1 billion to 10 billion moles/liter/day. Bacterial carbon production rates were estimated at 7-75 micrograms/liter/day, while specific growth rates were calculated to be between 0.2-1.1/day. During the destratification process, biomass increased steadily while production remained constant. However, during the period of maximum water-column homogeneity, production increased two-fold to threefold in 12 hr. Increased vertical mixing and stimulation of phytoplankton production were throught to be the major causes of this bacterial response to destratification. (Geiger-FRC)
W83-03264

CHEMICAL-QUALITY RECONNAISSANCE OF THE WATER AND SURFICIAL BED MATERIAL IN THE DELAWARE RIVER ESTUARY AND ADJACENT NEW JERSEY TRIBUTARIES, 1980-81,
Geological Survey, Trenton, NJ. Water Resources Div.
J. J. Hochreiter, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-151852, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigation 82-36, June 1982. 41 p, 6 Fig, 12 Tab, 52 Ref.

Descriptors: *Water quality, *Bottom sediments, *Path of pollutants, *Bottom sampling, Surface groundwater relations, Data collections, Chemical analysis, Trace metals, DDT, Pesticides, Polychlorinated biphenyes, Organic compounds, Salinity, *Delaware River, New Jersey, Pennsylvania, Delaware, EPA Priority pollutants.

This report presents chemical-quality data collected from May 1980 to January 1981 at several locations within the Delaware River estuary and selected New Jersey tributaries. Samples of surface water were analyzed Environmental Protection Agency 'priority pollutants,' including acid extractable, base/neutral extractable and volatile organic compounds, in addition to selected dissolved inorganic constituents. Surficial bed material at selected locations was examined for trace metals, insecticides, polychlorinated biphenyls, and base/neutral extractable organic compounds. Trace levels (1-50 micrograms per liter) of purgeable organic compounds, particularly those associated with the occurrence of hydrocarbons, were found in about 60% of the water samples taken. DDT, DDD, DDE, PCB's and chlordane are present in most surficial bed material samples. Diazinon was the only organophosphorous insecticide detected in the study (1.6 micrograms per kilogram at one location). High values for select trace metals in bed material were discovered at two locations. Of the 10 sites sampled, the surficial bed material containing the most contamination was found along one cross section of Raccoon Creek at Bridgeport. An additional analysis of Raccoon Creek revealed bed material containing toluene, oil and grease, and trace quantities of 15 base/neutral extractable organic compounds, including polynuclear aromatic hydrocarbons, phthalate esters, and chlorinated benzenes. (USGS)
W83-03363

RECOVERY AND TRANSPORT OF HEAVY METALS BY SPARTINA ALTERNIFLORA FROM DREDGING SPOILS,
Rhode Island Univ., Kingston. Dept. of Plant and Soil Science.
R. J. Hull, and J. R. Shann.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224428, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center Technical Report No 8, Univ. of Rhode Island, Kingston, September 1982. 23 p, 10 tab, 6 Ref. OWRT A-074-RI(1), 14-34-0001-1142.

Descriptors: *Spartina, Estuaries, Dredging, Cadmium copper, Nickel, Zinc, *Tidal marshes, Estuarine environment, *Rhode Island, Narragansett Bay, Sediments, *Metals, *Salinity, Absorption, *Path of pollutants.

The capacity of smooth cordgrass (Spartina alterniflora Loisel.) a dominant grass of Atlantic tidal salt marshes, to transport heavy metal from sediments to estuarine waters was studied. The DTPA extractable heavy metal content of marsh sediments from upper Narragansett Bay was correlated with the metal content of S. alterniflora growing in those sediments. The plant zinc content correlated well with the extractable zinc levels in the sediments. The plant content of cadmium, copper and nickel was best correlated with the sediment content of other metals. Plant cadmium was particularly well correlated with sediment zinc. The mobility of cadmium and zinc within S alterniflora was determined in solution cultured plants grown in 0 and 15 ppt NaCl. Salinity reduced the root absorption rate of cadmium and zinc by almost 50%. Translocation of zinc from roots to shoots was reduced by salinity while cadium transport was not affected. Both metals were phloem mobile translocating from leaves to roots and other sink regions. The presence of these metals on leaf surfaces following root absorption, indicated elimination from leaves via salt glands. These findings demonstrate that heavy metal absorption and transport occurs in S. alterniflora which can serve as a vector of

heavy metals from tidal marsh sediments to estuarine waters.
W83-03381

AGGREGATION OF COLLODIAL IRON DURING ESTUARINE MIXING: KINETICS, MECHANISM, AND SEASONALITY,
Maine Univ., Walpole. Dept. of Geological Sciences.
L. M. Mayer.
Geochimica et Cosmochimica Acta, Vol 46, No 12, p 2527, 2535, December, 1982. 8 Fig, 40 Ref.

Descriptors: *Iron, *Mixing, *Colloids, Estuaries, Kinetics, Seasonal variation, *Organic matter, Particulate matter, Suspended solids, Temperature effects, *Agregration.

The colloid chemistry of iron and humic aggregation was studied in a series of laboratory experiments, which were related to seasonal aggregation extent data collected in a temperate estuary. Kinetically, the aggregation of iron occurs with a rapid initial reaction which is complete within a few minutes, followed by an extensive, slow second reaction, which lasts for several hours. Organic carbon aggregation, however, occurs primarily in the first reaction. The first reaction is perikinetic, while the second reaction is observed to be either perikinetic or orthokinetic, depending on the pore size of the filter used to clarify the suspension. The second reaction involves aggregation of small filtrable colloids (< 0.5 microns) with larger aggregates formed in the first reaction, and follows pseudo-second order kinetics with respect to the filtrable iron concentration when finer filters (< 0.5 microns) are used for clarification. Little or no temperature dependence is evident for the first reaction extent, while increasing temperature strongly enhances the second reaction. An activation energy of 9-11 kcal per mole for the second reaction is due to a combination of trnsport and charge repulsion terms. Field data show a correspondingly greater aggregation extent of iron with salinity in warmer months relative to colder months. (Author's abstract)
W83-03450

PYRITE AND OXIDIZED IRON MINERAL PHASES FORMED FROM PYRITE OXIDATION IN SALT MARSH AND ESTUARINE SEDIMENTS,
Kean Coll. of New Jersey, Union. Dept. of Chemistry-Physics.
G. W. Luther, III, A. Giblin, R. W. Howarth, and R. A. Ryans.
Geochimica et Cosmochimica Acta, Vol 46, No 12, p 2665-2669, December, 1982. 4 Fig, 1 Tab, 27 Ref.

Descriptors: *Iron compounds, *Sediments, *Marshes, Salt marshes, Marine sediments, Estuaries, Chemical reactions, Pyrite, Sulfur compounds, Iron sulfide, Oxidation, Great Sippewissett Marsh, Massachusetts, Hackensack Meadowlands, New Jersey, Newark Bay, Sapelo Island, Georgia, Vegetation, Crystals, Framboids.

Sediments from vegetated portions of three salt marshes (Great Sippewissett on Cape Cod, Massachusetts; Sapelo Island, Georgia; and Hackensack Meadowlands, New Jersey) and from Newark Bay, New Jersey, Estuary were examined by scanning electron microscopy and energy dispersive X-ray analysis. Pyrite particles were abundant in sediment from all sites. They were found as framboids (5-40 microns, average 15 microns) and fine grained crystals (0.2-2.0 microns, average, 0.5 microns). Single crystals predominated in all samples of marsh sediments, strong evidence for rapid formation of pyrite. Microcrystalline and framboidal iron oxyhydroxides were found in many sediment samples, suggesting that pyrite oxidizes within the sediment and that iron is conserved in salt marshes during pyrite oxidation. Iron and zinc were found in oxidized framboids from Newark Bay. Crystalline iron oxyhydroxide phases were not detected in Sapelo Island sediments. The red amorphous coating on Spartina alterniflora roots from Sapelo and Sippewissett contained ferric iron (probably as oxide or hydroxide) as the major consituent, with some sodium chloride, goethite, and quartz. A proposed iron cycle in the pore waters of marsh sediments explains both the seasonal variations in amounts of pyrite found in marsh sediments and the low iron concentrations in pore waters. (Cassar-FRC)
W83-03451

HYDROBIOLOGY OF THE LITTORAL ZONE OF THE DNIEPER ESTUARY UNDER CONDITIONS OF REGULATED FLOW OF THE RIVER,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 6G.
W83-03480

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

BARGE-MOUNTED PLANT FOR DESALINATION: AN ECONOMICAL ALTERNATIVE FOR PROVIDING DRINKING WATER IN ARID REGIONS,
Buckau-Walther A.G., Essen (Germany, F.R.).
K. Wangnick.
Water and Waste Treatment, Vol 25, No 3, p 28, 30, 32, March, 1982. 3 Fig.

Descriptors: *Desalination, *Evaporation, Arid lands, Barges, Flash evaporation, Drinking water.

A mobile seawater desalination plant was built to supply drinking water for islands and construction sites in arid regions. Mounted on a 60 m long, 18.5 m wide self-propelled barge, the 1250 cu m per day unit includes 2 flash evaporators. Diesel oil is the source of heat for operating the unit as well as for propulsion. The plant was built in Europe and will be towed to the Middle East. A floating plant has several advantages over an onshore plant: shorter construction time; no roads, buldings, harbors or piers required; lower startup and trial operation costs; easier accessibility to fuel: lower cost per unit of drinking water produced; and the ability to move from one site to another. (Cassar-FRC)
W83-03179

FINAL RESULTS OF TESTING OF ABCOR 8 INCHES SPIRAL WOUND ULTRA-FILTERS AT THE WRIGHTSVILLE BEACH TEST FACILITY,
RCA Service Co., Camden, NJ.
L. H. Fleming.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220319, Price codes: A07 in paper copy, A01 in microfiche. Completion Report, June 1983. 108 p, 6 Fig, 4 Tab, 5 Append. OWRT C-00030-D(No 9405)(1).

Descriptors: *Seawater, *Membrane processes, *Water treatment, *Ultrafiltration, *Field tests, *Filters, Seawater filtration, Ultrafilters.

Utilizing 8 inches diameter spiral wound ultrafilter elements, an experimental system for the pretreatment of seawater was constructed and evaluated. Several different sets of operating conditions were tested. Three main parameters which varied were filtrate conversions, module flowrate and seawater temperature. Experimentally, it was found that there was no significant difference in the productivity between test runs with high module flowrates and those with low flow-rates. Low fifteen minute plugging indices of the filtrate indicate that ultrafilters are capable of supplying excellent feedwater. The energy consumption and productivity for a large system utilizing 48 eight inch spirals were projected. Operating at a transmembrane pressure of 100 psi and conversion of 90% the production rate for this seawater system would be 590,000 gpd at 75% and the specific energy consumption of the filtrate would be 2.2 Kwhr/Kgal. after 3600 hours of testing no degradation in the performance or condition of the ultrafilters were evident.
W83-03288

PARAMETRIC STUDY OF SEAWATER REVERSE OSMOSIS DESALTING PLANTS,
Bechtel Group, Inc., San Francisco, CA.
R. Soo-Hoo, S. May, and L. Awerbuch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220608, Price codes: A09 in paper copy, A01 in microfiche. Completion Report, January 1983. 180 p, 32 Fig, 70 Tab, 39 Ref, 2 Append. OWRT C-10141-D(No 1486)(1).

Descriptors: *Reverse osmosis, *Cost analysis, *Desalination, *Seawater, *Desalination plants, Membranes, Design criteria, Cost estimates, Pumps.

A comprehensive parametric technical and economic study on seawater reverse osmosis desalination plants was conducted to derive updated costs for seawater reverse osmosis plants ranging in capacity from 1000,000 gpd to 5 million gpd at a Carribean site and at a Continental U.S. site. The study considers hollow-fiber and spiral-wound membranes in one and two-pass configuration, various seawater intakes (surface, water well, Ranney collector), various high pressure pumping systems (centrifugal, positive displacement), optional energy recovery systems (Pelton wheel, reverse-running pumps, flow work exchanger), and operation and maintenance labor requirements. Process flow diagrams, piping and instrumentation diagrams, material lists, and plant layout diagrams were developed. Conceptual capital and operating cost estimates were prepared for the various base and parametric case plants to determine the product water costs.
W83-03316

ORGANIC ABSORBENTS FOR TRIPLE POINT ABSORPTION FREEZE CRYSTALLIZATION PROCESSES,
J. A. Heist.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222406, Price codes: A03 in paper copy, A01 in microfiche. Final Report, 1982. 34 p, 7 Fig, 3 Tab, 6 Ref. OWRT C-00247-D(1427)(1).

Descriptors: *Computer models, *Desalination, *Freezing, *Phase diagrams, *Waste heat, Construction materials, Corrosion, Equilibrium, Feasibility studies, Heat balance, Hydrocarbons, Immiscibility, Organic compounds, Pilot plants, Thermodynamics, Vapor pressure, *Absorbents, AFVC process, Absorption freeze vapor compression process, WHAF Process, Waste heat absorption freeze process.

Calculations were made to predict the absorption characteristics of various classes of organic molecules. Pertinent absorption refrigeration characteristics were found to be water-absorbent composition, miscibility of the absorbent and absorbed water, and the volatility of organic during regeneration operations. A number of absorbents were identified that could be used in the OWRT Absorption Freeze Vapor Compression (AFVC) pilot plant. The most promising materials are dicarboxylic acids (i.e., glutaric acid) and diols (tetraethylene glycol). Calculations to characterize the properties of these absorbents indicate that either would substantially improve operation of the AFVC pilot plant, which is limited by heat transfer surface area. Either of these materials will operate to allow greater mass and heat transfer driving forces than the present sodium chloride absorbent. Use of tetraethylene glycol is recommended ror the AFVC pilot plant at the Wrightsville Beach Test Facility. A method is presented for obtaining experimental water partial pressure data; this will confirm experimentally, before the organic absorbent is charged to the AFVC pilot plant, the temperature and concentration dependence of the water partial pressure in the absorbent solution. The tetraethylene glycol presents no handling hazards, is nontoxic, and is compatible with the materials in the AFVC pilot plant.
W83-03341

A CENTER FOR THE TRANSFER OF DESALINATION TECHNOLOGY,
Fairleigh Dickinson Univ., Teaneck, NJ. Coll. of Science and Engineering.
W. Arthur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-223057, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, June 1983. 43 p, 6 Fig, 4 Append. OWRT C-00101-D(No 0447)(1).

Descriptors: *Desalination, *Technology transfer, *Training, Brackish water, Chlorination, Electrodialysis, Reverse osmosis, Sea water, St. Croix, *Virgin Islands.

The Center was established at the Fairleigh Dickinson University, West Indies Laboratory, St. Croix, U. S. Virgin Islands. The main purpose was to demonstrate both the technical and economic merits of desalination to industry and the public at large. Primary emphasis was given to seawater desalting by reverse osmosis and brackish water conversion by electrodialysis. Research was conducted on pretreatment of raw seawater without employing acid and with a chlorine starvation technique. In addition, operators and engineers received hands-on training as the Center was used for both credit and non-credit educational courses.
W83-03352

BARRIER EFFECT OF VARIOUS METHODS FOR DESALINATING SEAWATER IN THE PRESENCE OF CHEMICAL POLLUTANTS (OBEZZARAZHIVAYUSHCHII EFFEKT RAZLICHNYKH METODOV OPRESNENIYA MORSKOI VODY V USLOVIYAKH EE KHIMICHESKOGO ZAGRYAZNENIYA),
Institute of General and Municipal Hygiene, Moscow (USSR).
Yu. A. Rakhmanin, Yu. G. Talaeva, and Yu. H. Nikitina.
Gigiena i Sanitariia, No 2, p 15-18, February, 1982. 10 Ref. English summary.

Descriptors: *Reverse osmosis, *Desalination, *Enterobacteria, *Pathogenic bacteria, *Distillation, Bacteria, Water treatment, Bioindicators, Oil pollution, Oily water, Seawater, Escherichia coli.

Distillation and reverse osmosis are the most reliable seawater desalination techniques as far as the elimination of pathogenic enterobacteria is concerned. The accumulation of pathogenic and indicator bacteria in desalinated water is influenced by the pollution of the initial water by surface active substances and oil products. In the course of desalination, the conventional indirect indices of water epidemiological safety, such as the coli-index and the total number of microorganisms, are not always meaningful. Determination of enterobacteria content should be carried out directly in the desalinated water. This is especially true when the surface-active substances or oil products contents of the initial seawater exceed the MAC by 10 times or the coli-index is greater than 1000. (Small-FRC)
W83-03404

FABRICATION OF A 6,000 GPD INDIRECT FREEZING PILOT PLANT: VOL. 1,
Chicago Bridge and Iron Co., Oak Brook, IL.
J. S. Andrepont.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-226829, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, October 1982. 20 p, 2 Fig, 6 Ref. OWRT C-00153-D(NO 0459)(1), 14-34-0001-0459.

Descriptors: *Desalination, *Freezing, Indirect contact, *Pilot plant, *Fabrication, *Desalination plants, Heat transfer, Design, Specifications, Design Criteria, Costs, Operations.

The indirect contact heat transfer freeze desalination process is presented and described. The scope of a contract for fabrication of a nominal 6000 gallon per day pilot plant is discussed. The design basis is reviewed and specifications and drawings are included to document the as-built facility. The check-out of the plant is reviewed and operation and maintenance are briefly discussed. Costs incurred during fabrication are briefly presented and the cost estimate for plant start-up and testing is reviewed. Five appendices are included in Volume II: (1) process design assumptions; (2) major equipment specifications; (3) electrical interlock description; (4) paint and lubricant specifications; (5) safety plan. As-built engineering and construction drawings are included in Volume III.
W83-03462

THE START-UP AND TESTING OF A 6,000 GPD INDIRECT FREEZE DESALINATION PILOT PLANT,
Chicago Bridge and Iron Co., Plainfield, IL.
C. M. Heavener, and T. J. Nowak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-226886, Price codes: A09 in paper copy, A01 in microfiche. Completion Report, March 1983. 59 p, 13 Fig, 3 Ref, 5 Append. OWRT C-10066-D(NO 1456)(1), 14-34-0001-1456.

Descriptors: *Desalination, *Indirect freezing process, *Pilot plant, Start-up, Testing, *Desalination plants, Operations, Brine, *Heat transfer, *Vertical tube crystallizers.

The report describes the techniques used to start-up, test, and evaluate an indirect freezing process using a pilot plant operating on a synthetic brine solution. Heat fluxes, overall heat transfer values, required temperature differentials and maximum ice production were determined in the operational testing of the falling film vertical tube crystallizer. The need for better quality control on the preparation of heat transfer surfaces was established and a new tube fabrication specification was prepared. Operating and control parameters for the pilot plant were determined for the optimum slurry flow rate, salinity of brine to the crystallizer, ice fraction to the wash column and water needed for ice washing. Additional research is indicated in several areas of mechanical design for the freezer, wash column, and separators.
W83-03468

3B. Water Yield Improvement

GROUND WATER QUANTITY AND QUALITY IN FRACTURE ZONES IN ABBEVILLE COUNTY, SOUTH CAROLINA,
Clemson Univ., SC. Dept. of Chemistry and Geology.
D. S. Snipes, G. G. Padgett, W. B. Hughes, and G. E. Springston.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-226860, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Publication No 102, Clemson Univ., S. C., June 1983. 54 p, 8 Fig, 8 Tab, 16 Ref, 2 Append. OWRT-A-053-SC(1), 14-34-0001-1143, 2143.

Descriptors: *Fracture Permeability, *Well data, Aerial photographs, Topographic maps, Groundwater, Bacteria, Chemical analyses, Dissolved solids, Hardness, Alkalinity, *South Carolina, Abbeville County, Water yield.

The coherent igneous and metamorphic rocks of Abbeville County in the Piedmont of South Carolina, are virtually impermeable except in fracture zones where their permeability is much better. Satellite imagery, aerial photographs, and topographic maps were analyzed in order to locate lineaments and fracture traces which are potential ground water bearing fracture zones attributed to systematic joints, faults or fold axes. These features were investigated in the field to confirm or deny that they were natural ones. More than 200 lineaments and fracture traces were mapped. The water wells situated in lineaments had a median yield of 35 gpm and the wells in fracture traces had a median of 25 gpm. In contrast, the wells located in unfractured rocks had a median of 5 gpm and 23% of these wells had yields of less than 2 gpm or were dry holes. Thus, the probability of obtaining a good to excellent well is much better on lineaments or fracture traces than it is for randomly situated ones. Seventy-one ground water samples were analyzed chemically. Ninety-five % of the samples were characterized by low total dissolved solids, hardness, alkalinity, chloride, Ca, Mg, Mn and Zn. The pH varied from 5.5 to 8.0 with a median of 6.6 Twenty-four of 71 samples had pH values which were less than 6.5, the lower limit recommended by SC DHEC. No bacteria were observed in six samples from drilled wells, but large concentrations were observed in all four of the samples from hand dug wells and in two out of three bored ones.
W83-03466

3C. Use Of Water Of Impaired Quality

EFFICIENT UTILIZATION OF INDUSTRIAL WASTER AND WASTE HEAT FOR INTENSIVE FISH PRODUCTION (DIE RATIONELLE NUTZUNG VON INDUSTRIEWASSER UND ABWARME FUR EINE INTENSIVE FISCHPRODUKTION),
VEB Binnenfischerei, Wermsdorf (German D.R.).
U. Seidlitz.
Wasserwirtschaft-Wassertchnik, Vol 32, No 8, p 274-275, 1982. 1 Tab. (No English Summary).

Descriptors: *Industrial water, *Fisheries, *Aquaculture, *Raw water, *Water temperature, Carp, Coal, Trout, Indicators, Bioindicators, Fish diets, Fish food, Growth, Fish management, Fish populations, Fish stocking.

Experience with fish production in industrial and cooling waters is recounted. Five installations near Leipzig and ten more throughout East Germany are Currently raising fish in industrial wastewaters for stocking or harvesting. Trout, carp, and plant-eating species have been successfully raised in such waters. With a fresh water input of about 300 cu m/hr in an open reciculating system, about 30 tons of carp or 20 tons of trout can be harvested annually. High quality mixed feed is required to optimize yield. Adequate influent monitoring is necessary, since process disturbances may affect the fishery operation before becoming otherwise apparent. It is possible to produce carp on a year-round basis, due to their water temperature requirements; optimal water temperatures range from 20 to 23 degrees centigrade for carp and 12 to 16 degrees centigrade for trout. High levels of pollutants in influent water sometimes become limiting factors for fish growth. (Titus-FRC)
W83-03221

A COMPUTER MODEL FOR PREDICTING THE IMPACT OF IRRIGATING WITH SALINE WATER ON SOILS AND RUNOFF WATER IN MISSOURI,
Missouri Univ.-Columbia. Dept. of Agronomy.
W. R. Teague, P. G. Koenig, A. Barakah, and R. W. Blanchar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219980, Price codes: A04 in paper copy, A01 in microfiche. Missouri Water Resources Center Completion Report, Univ. of Missouri, Columbia, January 1983. 65 p, 32 Fig, 14 Tab, 32 Ref, OWRT A-119-MO(1), 14-34-0001-0127.

Descriptors: *Irrigation water types, *Salinity, *Acid soils, Water quality, Soil physical properties, Leaching, *Soil water movement, Hydraulic conductivity, *Missouri, Model studies, Computer models, Runoff.

A study was undertaken to determine the potential impact of irrigating acid, loess derived soils with high salt/high sodium waters. The study was partly motivated by increasing practice of supplemental irrigation on soils overlying marginal quality groundwater aquifers and having moderately low available water holding capacities. A rudimentary data base, consisting of well water quality data (U. S. Geological Survey) and a period of record of solar radiation, precipitation and air temperature (SOLMET) was accessed and used to initiate a modeling effort. Hydraulic properties of remolded loess derived soil materials were studied as func-

tions of clay content (12 <% clay 41). Water content corresponding to a given value of matric potential increased with increasing clay content with one exception; for soils having 12 % and 20 % clay, this trend reversed for matric potentials higher than -60kPa. Within limits of experimental error, diffusivity and hydraulic conductivity were found to be exponential functions of water content over the matric potential range covered in the study. Saturated conductivity (falling head) decreased with increasing clay content and with increasing bulk density (1.3 to 1.4 gcm super -3). W83-03284

OPTIMUM IRRIGATION LOADING RATES OF HIGHLY SALINE WASTEWATER ON A MONTMORILLONITIC SOIL,
South Dakota State Univ., Brookings. Water Resources Research Inst.
J. H. Bischoff, and C. G. Carlson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222166, Price codes: A08 in paper copy, A01 in microfiche. Completion Report, May 1983. 166 p, 29 Fig, 18 Tab, 19 Ref, 9 Append. OWRT A-072-SDAK(1), 14-34-0001-9044.

Descriptors: *Land management, *Irrigation water, *Water reuse, Wastewater disposal, Wastewater use, Brackish water, Alkaline water.

Annual applications of 125, 90, and 50 cm of secondary-treated municipal effluent were applied to a 0.76 cm/hr glaciated soil growing alfalfa for 3 years. All treatments had weekly applications with the depth of application varying from 1.5-3.2 cm for the low rate plot to 3.8-8 cm for the high plot. The amounts applied paralled the evapotranspiration curve of the crop with weekly applications lowest in the spring and fall and highest during the summer. Water quality varied from 1500-3000 mu Siemens/cm for the electrolyte concentration, from 5-11 for the sodium adsorption ratio, and from 0.1-12.4 ppm for nitrate nitrogen. A water table developed within 1.2 meters of the surface for the 90 cm plot (treatment 35G) and within 1.1 meters of the surface on the 125 cm plot (treatment 50) at the end of the second irrigation season. Treatment 50 had lost 1-2% of the plant population at the end of the second year and 15-20% by the end of the third year of irrigating. Leaching fractions of 0.08-0.10 for total moisture should not be exceeded to prevent water table problems from developing near the surface. Annual soil applications of gypsum were added to the 90 cm plot (treatment 35G) to determine the efficiency in removing exchangeable sodium from the soil colloid exchange sites. After two annual applications of powdered gypsum, no significant difference between the gypsum plot (treatment 35G) and the non-gypsum plot (treatment 35) was detected in the top 1.2 meters. However, the sodium level for 35G in observation wells at the center of the plot were 2-5 times higher than the non-gypsum plot (35) with the same annual rate of effluent. Sulfate levels were 4-8 times higher on 35G versus 35 and magnesium was 4 times higher.
W83-03327

WATER QUALITY OF AIRPORT STORM RUNOFF,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W83-03353

WATER REUSE IN THE COASTAL PLAIN OF NEW JERSEY - A CASE STUDY,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
R. C. Ahlert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224386, Price codes: A02 in paper copy, A01 in microfiche. Center for Coastal and Environmental Studies Completion Report, May 1983. 9 p, 6 Ref. OWRT A-059-NJ(1), 14-34-0001-0132/1132.

Descriptors: *Water reuse, Water supply, Wastewater renovation, Water deficit, *New Jersey, Coastal plains, Manasquan River basin, Recharge, Water quality criteria, Wastewater treatment.

Eastern Monmouth County has an increasing water deficit, as evidenced by declining aquifer levels and increasing salinity. Waste water reuse through aquifer recharge was considered a possible alternative to surface water development. Surface water development in the Manasquan River Basin would involve reuse through treated effluent transport in surface waters to impoundments or potable water intakes. Recharge lagoons and irrigation requirements could not provide adequate capacity. Water quality criteria would mandate considerable tertiary treatment before injection and mixing with ground water. Water Plant 21 is an example of complexity and cost for treatments prior to reuse via aquifer. A dual distribution system concept would provide some relief of demand of potable water. Treated waste water can be used for many non-potable, non-contact purposes.
W83-03378

THE USE OF INDUSTRIAL WASTE WATER. I. AERIAL AND SOIL MICROCLIMATIC MODIFICATIONS DUE TO HEATING BY WASTEWATER (20 DEGREES C) CIRCULATING IN BURIED PIPES (UTILISATION DES EAUS DE REJET EN AGRICULTURE, I. MODIFICATIONS MICROCLIMATIQUES DUES AU CHAUFFAGE DU SOL PAR TUYAUX ENTERRES, EN PLEIN CHAMP)
Institut National de la Recherche Agronomique, Versailles (France). Station de Bioclimatologie.
A. Baille, and M. Mermier.
Agricultural Meteorology, Vol 22, No 1, p 23-34, July, 1980. 8 Fig, 2 Tab, 9 Ref. English summary.

Descriptors: *Heated wastewater, *Soil temperature, *Powerplants, Nuclear powerplants, Primary productivity, Crop yield, Nuclear powerplants, Primary productivity, Crop yield, Wastewater management, Waste heat, Wastewater farming, Wastewater disposal.

Wastewater from thermal or nuclear power stations might be employed for agricultural purposes. One such use consists of soil heating by circulating wastewater in buried pipes. It is necessary to determine the order of magnitude of the microclimatic modifications introduced by this heating process. Microclimatic measurements (temperatures, radiative balance) were made in two open field cultivated plots, one heated by buried pipes with water at 20 degrees C, and the other non-heated. On a very cold night (temperature at 10 cm above the soil, 2-8C) an average temperature elevation of 2 deg. C was achieved. This would not be sufficient to protect the crops against a hard freeze. Modifications of the thermal regime were significant in the soil (temperature as well as fluxes) but negligible in the air above 20 cm. Thus, greater benefits in terms of earlier maturation and productivity are to be expected for underground cultures such as asparagus, potatoes, and similar crops. (Baker-FRC)
W83-03388

PROBLEMS OF IRRIGATED AGRICULTURE IN AL-HASSA, SAUDI ARABIA,
Regional Centre for Animal Nutrition and Breeding, Hofuf (Saudi Arabia).
Z. Hussain.
Agricultural Water Management, Vol 5, No 4, p 359-374, December, 1982. 9 Fig, 1 Tab, 26 Ref.

Descriptors: *Irrigation practices, *Springs, *Salinity, *Saudi Arabia, Salt, Crop yield, Sugarbeets, Barley, Water management, Water supply development, Irrigation.

Al-Hassa, often referred to as the largest and oldest oasis in the Arabian Peninsula, is located in the eastern part of Saudi Arabia. Not long ago the area under intensive cultivation in Al-Hassa was as large as 20,000 ha. However, poor drainage initiated a process of gradual but continuous decline in soil productivity. During the late 1960's, 32 springs were integrated to form the present Al-Hassa Irrigation and Drainage Authority; work was completed in 1971. A recent study showed that the total discharge from the springs was 219 million cubic meters per year. The water is of a high salinity and is not suitable for irrigation under normal conditions, but only under very careful soil management. In the Al-Hassa Irrigation and Drainage Authority, management of drainage water for agricultural use has been under consideration as a possible means of enlarging the area under cultivation. Several studies were carried out to determine the long-term effects of using highly saline water for irrigation. Experiments applying irrigation water with a salinity level ranging from 1555 to over 5000 mg/liter were carried out for the test crop, alfalfa, over a 3 year period. Crop yield was reduced by about 18% in plots treated with water of salinity 3800 mg/liter, as compared with the plots irrigated with normal water. Sugar beet, Rhodes grass and barley could be grown when the salinity level was less than 400 mg/liter. It is concluded that the construction of effective irrigation and drainage facilities and their proper exploitation in areas affected or endangered by secondary salinization is the most vital and urgent problem of irrigated agriculture in the Al-Hassa oasis. (Baker-FRC)
W83-03391

3D. Conservation In Domestic and Municipal Use

THE CONCORD WATER SURVEY,
New Hampshire Univ., Durham. Water Resources Research Center.
L. C. Hamilton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-223040, Price codes: A04 in paper copy, A01 in microfiche. Research Report No 38, January 1983. 68 p, 8 Fig, 10 Tab, 14 Ref, 3 Append. OWRT A-061-NH(3), 14-34-0001-2131.

Descriptors: *Water conservation, *Survey, Residential, Evaluation, *New Hampshire, Concord, *Water shortage, Water use, Domestic water supply, Attitudes.

The city of Concord, New Hampshire, experienced a serious water shortage in 1980-81. An energetic conservation campaign was evidently successful, as city-wide use declined by some 15% during the shortage. This study uses data from a mailed survey questionnaire, combined with information from Water Department billing records, to examine the predictors of water conservation in a random sample of 431 Concord households. The most important single predictor of household conservation is baseline, preshortage water use. The greater the pre-shortage use, the greater the use reduction, in both absolute and in percentage terms. This effect remains strong even with more than twenty other variables in the model. The most important steps taken to conserve water are indoors, behavioral changes such as less flushing of toilets, shorter showers, shallower baths, etc. Reductions in outdoors water use were almost universally claimed by these households, so this variable cannot account for within-sample variations in conservation. The indoors, behavioral changes are most closely related to idealistic, rather than economic, motives for saving water. Idealistic motives are highest among younger, more affluent, and better-educated households. Economic motives, in contrast, are higher among less affluent and educated households, with larger numbers of children. People citing economic motives may actually have conserved less water than others. This study represents the first attempt to construct a full causal model for household water conservation. The findings have implications both for water-conservation program design, and for the direction of possible future research.
W83-03351

3E. Conservation In Industry

WATER REUSE AND RECYCLING IN THE TEXTILE INDUSTRY,
Environmental Technology Consultants, Inc., Fairfax Station, VA.
J. C. Dyer, J. S. Whang, and J. F. Judkins, Jr.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83-212266, Price codes: A09 in paper copy, A01 in microfiche. Completion Report RU-83/1, U.S. Dept. of the Interior, Bur. of Reclamation, Washington, D.C., April 1983. 163 p, 33 Fig, 8 Tab, 25 Ref, 3 Append. OWRT C-10014-R(No 2402)(1), 14-34-0001-2402.

Descriptors: *Recycle, *Reuse, *Textile industries, Water usage, Wastewater characteristics, *Water reuse.

An assessment was made of the current extent of water reuse and recycling within the Textile Industry and areas were identified for increased utilization of reuse and recycling modes of operation. An overview of water usage within the Textile Industry is presented. The two largest subcategories--woven fabric finishing and knit fabric finishing--represent approximately 80-85% of the wet-processing mills in the U.S. and approximately 80% of these large water users are located in the Mid-Atlantic and South-Atlantic-Gulf regions. A summary of the nine major product classes with process and wastewater characteristics is presented Applicable waste treatment technologies are summarized and a computer model to be used by management in planning reuse/recycle options is presented. Four detailed case histories on actual operating mills, utilizing various recycle modes of operation, are included. The areas identified for future research activities include: refined management tools including computer models, actual minimum feed water quality parameters for major water-using processes, cost-effective alternative treatment technologies, and development of effective in-plant modifications coupled with new process equipment.
W83-03178

3F. Conservation In Agriculture

AGRICULTURAL IRRIGATION TECHNOLOGY TRANSFER ASSESSMENT,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
C. A. Marro, E. M. Roe, and W. E. Sharpe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219956, Price codes:A04 in paper copy, A01 in microfiche. Completion Report, February 1982. 49 p, 5 Append. OWRT C-00192-T(No 0496(2), 14-34-0001-0496.

Descriptors: *Technology transfer, *Agricultural irrigation, *Irrigation efficiency, *Technology transfer products, *User needs assessment, Products strengths, Product weaknesses, Users identified, Western U.S., Southeastern U.S.

The assessment of agricultural irrigation technology transfer begins with a short history of irrigation and a discussion of problems caused by inefficient irrigation methods. A description of the search strategy--which included a literature search, consultation with computerized information files, contact with irrigation experts and government agencies--follows. Groups and individuals who may use agricultural irrigation technology are identified and characterized by number and geographical distribution. User needs, such as technical level of information or publication format, are discussed. Significant research and technology transfer products, along with strengths and weaknesses are included. The Federal or State agencies, associations or corporations which produced the products are listed. A section is devoted specifically to technology transfer produced in the Southeast because many products and programs have been produced in the region. The need for efficient irrigation water use in the southeast is not as serious as it is in the western states. Therefore, this section is the only part of the assessment which discusses the eastern U. S. Recommendations are made for five technology products and programs. Format, topic outlines, and cost-benefit analyses are included where appropriate. Supplemental appendix sections list interested government agencies, names and addresses of contacts, journals, associations, and technology transfer products.
W83-03281

CONSERVATION OF SOIL, WATER, ANDD ENERGY THROUGH REDUCED TILLAGE SYSTEMS - PHASE I SUB 1,
Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4D.
W83-03287

LANDSAT MONITORING OF IRRIGATED FARMLAND ACREAGE IN CURRY COUNTY, NEW MEXICO,
New Mexico Univ., Albuquerque. Technology Application Center.
For primary bibliographic entry see Field 7A.
W83-03310

TILLAGE AND IRRIGATION MANAGEMENT PRACTICES FOR OPTIMUM CROP PRODUCTION,
South Dakota State Univ., Brookings. Dept. of Agricultural Engineering.
D. W. DeBoer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222182, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Institute Completion Report, South Dakota State Univ., Brookings, March 1983. 68 p, 26 Fig, 16 Tab, 45 Ref. OWRT A-076-SDAK(1), 14-34-0001-0144.

Descriptors: Irrigation, *Cultivation, Conservation tillage, *Sprinkler irrigation, Runoff, Infiltration, Rates of application, Water management, *Chiselling, Irrigation efficiency, Crop response, *South Dakota.

Field studies dealing with the management of reduced pressure sprinkler irrigation technology were conducted in South Dakota. The objectives of the studies were to evaluate the characteristics of the experimental sprinklers and companion tillage practices. Eight sprinkler devices (impact sprinklers, a vortex nozzle and spray nozzles on booms and on top of the pipe with operating pressures ranging from 41 to 344 kPa) were field tested on a silt loam soil. The maximum application intensities were influenced by climatic conditions and sprinkler device selection. High application uniformities were obtained with high and low pressure sprinkler devices. The reduced pressure sprinklers produced increased application intensities, increased surface runoff and decreased soil water contents for conditions of the study. No corn yield differences were detected among the experimental sprinkler devices because the irrigation management practices used in the study maintained adequate soil water contents. Three primary tillage (plow, disc and till-plant) treatments and one secondary tillage practice were evaluated under reduced pressure sprinkler irrigation. The disc treatment produced 35% less runoff than the plow and till-plant treatments. The plow and till-plant treatments produced comparable amounts of runoff. The plow treatment had less soil water available for crop use than the disc and till-plant treatments. The plow treatment caused a 1.4 mg/ha corn yield reduction when compared with an average of the other tillage treatments. The secondary tillage practice reduced surface runoff by 63%, increased soil water contents and increased corn yields by an average of 0.5 mg/ha.
W83-03329

WATER AND ENERGY CONSERVATION USING CENTER PIVOT IRRIGATION AND REDUCED TILLAGE SYSTEMS,
Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
J. R. Gilley, L. N. Mielke, and W. W. Wilhelm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222398, Price codes: A05 in paper copy, A01 in microfiche. Nebraska Water Resources Center Completion Report, Lincoln, October 1982. 83 p, 19 Fig, 27 Tab, 11 Ref. OWRT B-048-NEB(1), 14-34-0001-9120.

Descriptors: *Water conservation, *Center-pivot irrigation, *Energy conservation, *Irrigation efficiency, *Nebraska, Mathematical models, Reduced pressure, Sprinkler irrigation, Water quality.

The basic goal of this project was to develop and evaluate crop production systems which have the potential to reduce both water and energy consumption in irrigated agriculture without adversely affecting water quality. A combination of field experimentation and computer modeling was undertaken to determine the quantity and quality of runoff water from reduced-pressure center-pivot irrigation systems, to determine the water and energy savings from these systems, to develop mathematical models of these systems, and to determine the feasibility of using these systems in other locations. Reducing the pressure of center-pivot systems can save significant amounts of energy; however, improper site selection for some types of these systems may result in increased runoff. The increased runoff will lower the irrigation efficiency and the potential energy savings will be reduced, nullifying part of the energy savings gained through pressure reduction. The incorporation of modified tillage practices will greatly reduce the runoff problem. Mathematical models of the water application characteristics of center-pivot systems and soil infiltration rates were used to develop criteria for proper site selection of reduced pressure systems. These criteria can be used to determine the feasibility of using the various reduced pressure devices as a function of soil intake families.
W83-03342

EFFECT OF IRRIGATION AND HARVESTING DATES ON THE YIELD OF SPRING-SOWN SUGAR-BEET,
Naples Univ. (Italy). Inst. of Agronomy.
G. Barbieri.
Agricultural Water Management, Vol 5, No 4, p 345-357, December, 1982. 5 Fig, 4 Tab, 21 Ref.

Descriptors: *Irrigation practices, *Crop yield, *Sugar-beet, Irrigation, Water supply development, Water supply, Evaporation, Temperature effects, Rainfall, *Italy, Sele River Plain.

A 2-year trial study was conducted on sugar-beet sown in the spring in the Sele River Plain in Southern Italy. During the study 4 watering regimes were compared in factorial combination with two harvesting dates. In addition to no irrigation, three different irrigation schedules were applied during the growing season. These were based on the net accumulated pan 'A' evaporation, the crop coefficient and an irrigation cycle coefficient. During the first year, highest yields of roots and sucrose were obtained with the largest water depths (555 and 655 mm for the two irrigation dates), applying short irrigation cycles. In the second year, with intermediate water depths of 300 and 350 mm and intermediate irrigation cycles, highest yields were obtained. Irrigation increased mean weight and size of roots and decreased sucrose percentage. A 1 month delay in harvest increased mean weight, sizes and yield of roots and decreased the sucrose percent although the final sucrose yield was not changed. (Baker-FRC)
W83-03383

A METHOD FOR APPLYING CROP SENSITIVITY FACTORS IN IRRIGATION SCHEDULING,
Demokritos Univ. of Thrace, Xanthi (Greece). Dept. of Civil Engineering.
G. P. Tsakiris.
Agricultural Water Management, Vol 5, No 4, p 335-343, December, 1982. 2 Fig, 1 Tab, 22 Ref.

Descriptors: *Irrigation practices, *Crop production, Moisture stress, *Sorghum, *Irrigation, Water supply development, Water management.

Attention is focused on the parameter representing crop sensitivity in a production function. A method is presented for modification of this parameter, derived from experiments, to make it suitable for application in irrigation practice. The procedure is illustrated using data for grain sorghum. Using Jensen's production function a method was devised for estimating crop sensitivity to water deficiency at given time intervals. The sensitivity index was closely related to the duration of the suppression of evapotranspiration. Thus, values of

the sensitivity index encountered in the literature without specifying the exact duration of the corresponding period have qualitative rather than quantitative validity. These values should not, therefore, be used for optimization purposes. The method proposed has the great advantage of simplicity. This is mainly achieved by disregarding the complicated interdependence between the stages of growth. Due to this simplification the volume of data required for constructing such a production function can be substantially reduced. The method is suitable for use in the design and operation of irrigation systems. It permits considerable flexibility in selecting the irrigation interval to take into account the various climatic and soil conditions. It may be used to optimize the intraseasonal irrigation water distribution for a single crop when the available irrigation water for the season is limited. (Baker-FRC)
W83-03384

PROBLEMS OF IRRIGATED AGRICULTURE IN AL-HASSA, SAUDI ARABIA,
Regional Centre for Animal Nutrition and Breeding, Hofuf (Saudi Arabia).
For primary bibliographic entry see Field 3C.
W83-03391

IRRIGATION WATER CONSERVATION BY USING WIDE-SPACED FURROWS,
Oklahoma State Univ., Stillwater. Dept. of Agronomy.
J. F. Stone, H. E. Reeves, and J. E. Garton.
Agricultural Water Management, Vol 5, No 4, p 309-317, December, 1982. 4 Tab, 7 Ref.

Descriptors: *Irrigation practices, *Crop yield, *Furrow irrigation, *Water conservation, Water requirements, Sorghum, Water stress, *Oklahoma.

Wide furrow irrigation, which can reduce water requirements by 20-50%, was studied in 1977 and 1978 in a grain sorghum field in Goodwell, Oklahoma, to develop management practices for avoiding crop yield reductions commonly reported with this technique. Yield reductions were not encountered if the wide-spaced furrow irrigation method was abandoned for normal (every furrow) irrigation methods on August 1 of a high water stress year or if the furrows were irrigated alternately. A high stress year was identified by examining wind velocity and rainfall for the period July 15 to August 1. If rainfall average was $<$ 1.6 mm per day and wind average was $>$ 1.8 m per sec during this two-week period, the irrigation program was immediately changed to every-furrow irrigation or alternate furrow irrigation. (Cassar-FRC)
W83-03408

ANALYSIS OF BASIN IRRIGATION PERFORMANCE WITH VARIABLE INFLOW RATE,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
J. M. Reddy, and W. Clyma.
Agricultural Water Management, kVol 5, No 4, p 295-308, December, 1982. 10 Fig, 5 Tab, 12 Ref.

Descriptors: *Irrigation efficiency, *Flow rate, *Variability, Basin irrigation, Surface irrigation, Model studies, Mathematical models, Performance evaluation, Design criteria, Developing countries, *Egypt, Semiarid lands, Water conservation.

Variability in irrigation flow rate did not lower the performance of a basin irrigation system when the average flow rate was greater than or equal to the design flow rate. These results were obtained by using data from two Egyptian field sites in a mathematical model, the zero-inertia model of surface irrigation. Three patterns of flow variation (sinusoidal, initially low then high, and initially high then low) were studied. On sandy loam soil the distribution uniformity was reduced at 0.75 times design flow, and water did not reach the end of the field at 0.5 times the design flow. The clay loam field had acceptable performance even at half of the design flow rate. If average flow rates are not high enough, the basin size can be reduced to achieve the desired application efficiency and distribution uniformity. (Cassar-FRC)
W83-03410

FORECASTING METHODS IN THE FUTURE SUPPLY AREA OF THE RHEINTAL WATER TRANSMISSION NETWORK (BEWEISSICHERUNGSVERFAHREN IM KUNFTIGEN WASSERGEWINNUNGSGEBIET DES ZWECKVERBANDS FERNWASSERVERSORGUNG RHEINTAL (FWR),
Zweckverband Fernwasserversorgun Rheintal, Sinsheim (Germany, F.R.).
J. Thon, and P. Fellmann.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 2, p 41-44, February, 1981. 2 Fig, 1 Tab, 4 Ref. English abstract.

Descriptors: *Crop yield, *Crop production, *Available water, *Infrared imagry, *Aerial photography, Agriculture, Cropland, Photography, Computers, Forecasting, Prediction, Weather data collections, Federal Republic of Germany.

In a test area of 11.4 sq km with varying soil conditions, agricultural yields were determined before and after the removal of 1000 to 2000 liters/sec of water for a long distance water supply. The purpose was to determine possible reductions in agricultural yields and to develop a method to compensate for the loss in yield. A new procedure was used which involves the computerized evaluation of infra-red aerial photographs taken with false-color film. The procedure was standardized using the yields of small test fields. Also, a method for forecasting crop yields based on weather data was applied for the first time on a regional basis. This method has proven useful for the determination of average yields for various countries. (Author's abstract)
W83-03456

TECHNOLOGY ASSESSMENT OF IRRIGATION SCHEDULING AND CROP RESPONSE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
W. A. Hall.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-226902, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, February 1982. 102 p, 8 Fig, 3 Tab, 168 Ref, 2 Append. OWRT C-00179-T (No 0472)(1), 14-34-0001-0472.

Descriptors: Agriculture, *Crop production, *Farming, Irrigation, *Irrigation effects, *Irrigation practices, *Technology assessment, *Irrigation scheduling, Crop yeild.

During the 1970s decade, the United States underwent a dramatic shift in the political philosophy for irrigation planning and management, from one of continually seeking to augment the existing supplies of irrigation water to one of better utilization and management of those supplies already developed. This change in emphasis has been neither complete nor without controversy, primarily because the relevant science and technology implicitly required for the rational evaluation of the new philosophy is largely undeveloped. It is the objective of this technology assessment to evaluate the requirements which must be met if the new philosophy is to serve national objectives most effectively, to assess the current state of the related science and technology, and to recommend research and development programs which will be required. The basic issues are the amount, timing and uniformity of the application of irrigation water to the fields and the consequences thereof. These issues are important to a number of questions relevant both to good farm water management and to the implications of various proposed national water policies.
W83-03488

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

EFFECT OF HYDOUT AND AQUATHOL K ON HYDRILLA IN GATUN LAKE, PANAMA,
H. E. Westerdahl.
Journal of Aquatic Plant Management, Vol 21, p 17-21, January, 1983. 7 Fig, 2 Tab, 13 Ref.

Descriptors: *Herbicides, *Aquatic weed control, *Pesticide residues, *Pesticide kinetics, Aquatic weeds, Lakes, Canals, Macrophytes, Aquatic plants, Lake sediments, Plant tissues, *Panama, Gatun Lake.

Three equivalent treatment rates of two endothall formulations (27, 34, and 50 kilograms/hectare of Aquathol K and Hydout) were effective at controlling hydrilla in treatment plots of the Frijoles Bay area of Gatun Lake , Panama. Aquathol K provided control within 24 to 72 hr posttreatment at each application rate while Hydout required 14 to 21 days before hydrilla decline was evident at the two higher application rates. Herbicide dispersion from the Aquathol K treated area was evident during the first three days after application. Persistance of endothall in water of treated plots was less than 7 days. Endothall persistence in sediment and plant tissue from treated plots was about 3 and 7 days, respectively, for Aquathol K and over 21 days for Hydout. (Geiger-FRC) thin 24 to 72 hr posttreatment at each application rate while Hydouapplication rates. Herbicide dispers ion from the Aquathol K treated area was evident during the first three days after application. Persistence of endothall in water of treated plots was lessthin 24 to 72 hr posttreatment at each application rate while Hydouapplication rates. Herbicide dispers ion from the Aquathol K treated area was evident during the first three days after application. Persistence of endothall in water of treated plots was lessthin 24 to 72 hr posttreatment at each application rate while Hydouapplication rates. Herbicide dispers ion from the Aquathol K treated area was evident during the first three days after application. Persistence of endothall in water of treated plots was less than 7 days. Endothall persisr Aquathol K and over 21 days for Hydout. (Geiger-FRC)
W83-03162

THRESHOLD 2,4-D CONCENTRATIONS FOR CONTROL OF EURASIAN WATERMILFOIL AND SAGO PONDWEED,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
H. E. Westerdahl, and J. F. Hall.
Journal of Aquatic Plant Management, Vol 21, p 22-25, January, 1983. 3 Fig, 4 Tab, 11 Ref.

Descriptors: *Aquatic weed control, *Sago pondweed, *Herbicides, Pesticides, Aquatic weeds, Aquatic plants, Pesticide toxicity, Macrophytes, Plant growth, Halogenated pesticides.

The minimum sustained concentrations of controlled release (CR) formulation of 2,4-dichlorophenoxy acetic acid (2,4-D) required to control the growth of Eurasian watermilfoil and Sago pondweed was determined in specially designed dilution tests. Five dilutions of 2,4-D (0.00, 0.03, 0.05, 0.10, and 0.25 milligrams/liter) were delivered to five sets of four test aquaria containing meristematic cuttings of Eurasian watermilfoil and germinated tubers of Sago pondweed growing in beakers of standardized peat:sand mixtures. Plant injury was assessed by growth and biomass measurements recorded periodically during 11 weeks of continuous exposure to the various 2,4-D concentrations. Results indicated that the 2,4-D threshold concentrations needed to control Eurasian watermilfoil and Sago pondweed were between 0.10 to 0.25 milligrams/liter, respectively. (Geiger-FRC)
W83-03163

AQUATIC PLANT CONTROL AND DISAPPEARANCE OF TERBUTRYN FROM TREATED WATERS IN ONTARIO, CANADA, 1974-1977,
Ontario Ministry of the Environment, Toronto.
D. Mackenzie, R. Frank, and G. J. Sirons.
Journal of Aquatic Plant Management, Vol 21, p 11-16, January, 1983. 7 Tab, 5 Ref.

Descriptors: *Herbicides, *Aauatic weed control, *Water pollution effects, *Pesticide residues, *Fate of pollutants, Aquatic plants, Lake sediments, Aquatic weeds, Algal control, Dissolved oxygen, *Ontario.

Between 1974 and 1978, 13 ponds and 12 lake plots were treated with terbutryn for the control of a wide variety of aquatic plants. Analyses of water and sediment samples showed that about half of the applied herbicide remained in the water column while half was deposited in the sediment. Where currents carried the herbicides out of the treated area, the terbutryn had little effect on aquatic plants. Control of aquatic plants was very good when water flow was interrupted for 10 days, but rotting plant material depleted oxygen levels, affecting some fish species. The best aquatic plant control occurred under static or nearly static water conditions. Terbutryn was most effective against filamentous algae, less effective against submersed vascular aquatic plants, and least effective against emerged aquatic plants. Low residues of terbutryn were identified in sediments 12 months after treatment. (Geiger-FRC)
W83-03166

FISHERIES PRODUCTIVITY AND WATER LEVEL FLUCTUATIONS IN LAC SEUL, NORTHWESTERN ONTARIO,
Hanna (J.E.) Associates, Inc., Mississauga (Ontario).
For primary bibliographic entry see Field 6G.
W83-03212

FIELD EVALUATION OF A WATER MANAGEMENT SIMULATION MODEL,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs.
Transactions of the ASAE, Vol 25, No 3, p 666-674, May/June, 1982. 10 Fig, 7 Tab, 28 Ref.

Descriptors: *Water management, *Drainage, *Model studies, DRAINMOD, Simulation, Surface drainage, Subsurface drainage, Irrigation, Sprinkler irrigation, Subsurface irrigation.

Field studies are reported to test the reliability of the water management simulation model, DRAINMOD. The model was developed for design and evaluation of multicomponent water management systems which could include facilities for subsurface drainage, surface drainage, subirrigation and sprinkler irrigation. The model can be used to simulate the performance of a water management system design over a long period of climatological record. By evaluating several designs, the alternative system which satisfies the design objectives at the least cost can be identified. DRAINMOD is based on a water balance in the soil profile. It is composed of a number of separate components which evaluate the various mechanisms of soil water movement and storage. Three soil types and five different drainage system designs were included in the experiment from which 21 site-years of data were obtained. Rainfall intensity and water table elevations were compared to predicted values. Comparison of predicated and measured water table elevations were in excellent agreement with the daily water table depths having standard errors of estimate ranging from 7.5 to 19.6 cm. The average absolute deviation between predicted and observed water table depths for 21 site-years of data was only 8.1 cm. Based on these findings, DRAINMOD can be reliably used to predict the effect of drainage system design on water table elevations. (Baker-FRC)
W83-03238

INFLUENCE OF AGRICULTURAL DRAINAGE ON WATER QUALITY,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W83-03289

URBAN FLOOD DAMAGE ESTIMATING CURVES,
Georgia Inst. of Tech., Atlanta.
For primary bibliographic entry see Field 2E.
W83-03294

WORTH OF INFLOW FORECAST FOR RESERVOIR OPERATION,
California Univ., Los Angeles. School of Engineering and Applied Science.
W. W. -G. Yeh, L. Becker, and R. Zettlemoyer.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR3, p 257-269, October, 1982. 4 Fig, 6 Tab, 6 Ref. OWRT C-7099(6209).

Descriptors: *Reservoir operation, *Streamflow forecasting, *Benefits, Reservoir releases, Hydroelectric power, Water conservation, Beneficial uses, Flood control, Seepage control, Forecasting, Simulation analysis, Water storage, Pumped storage, Oroville-Thermalito Reservoir, *California.

Consideration of long-range (one month to one year) streamflow forecasts in the operation of Oroville-Thermalito Reservoir, California, a multipurpose reservoir with pumped storage, would produce several benefits: increased hydropower production, water conservation for irrigation and/or other beneficial uses, and decreased seepage damage to crops. Flood control benefits are potentially high, but can be attained using short-term predictions of several days. The reservoir was theoretically operated for the period 1914-73 with contractual requirements and agreements as absolute restraints, adjusting releases to enhance benefits as streamflow predictions allowed. On the average, releases were made during the first half of the month to conform with predicted monthly flow and during the second half in conformity with actual inflow to produce an end-of-the-month storage reflecting actual inflows and releases. Hydropower benefits were improved up to 3.56% using long-range forecasts and up to 6.48% using the historical mean streamflows. Releases were made according to streamflow prediction to leave storage space for potential spills. Benefits from releasing water for beneficial uses in June-September were increased 22-24% using the long-range forecast method and 22% using the historical mean. Seepage, which occurs at flows greater than 85,000 cfs, is most likely in April-June (snowmelt period). Simulation with current operation policies produced 13 seepage events during the 60 year period. Accurate prediction of spring streamflows during the previous winter could reduce high flow events to zero. Using either the method in this paper or the historical mean to determine reservoir releases prevented 7 of the seepage events. The risky nature of using historical means to predict streamflow and operate a reservoir was illustrated by the lower-than-observed storage levels simulated for the 1976-77 drought. (Cassar-FRC)
W83-03296

THE BIOLOGICAL REGULATION OF BLOOM-CAUSING BLUE-GREEN ALGAE: A FEASIBLE ALTERNATIVE,
Nebraska Univ., Lincoln. School of Life Sciences.
For primary bibliographic entry see Field 5C.
W83-03311

REAL-TIME FORECASTING OF RIVER FLOWS AND STOCHASTIC OPTIMAL CONTROL OF MULTIRESERVOIR SYSTEMS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
P. K. Kitanidis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-221762, Price codes: A04 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute Completion Report No 133, Iowa State Univ., Ames, March 1983. 52 p, Fig 3, 47 Ref, 1 Append. OWRT A-083-IA(1), 14-34-0001-2117.

Descriptors: *Reservoirs, *Optimization, *Forecasting, Model studies, Stochastic processes, *Reservoir operation, *Risks, *Certainty equivalent, Control systems.

An examination was made of the interaction between stochastic forecasting and optimization in the real-time operation of reservoir systems. The problem of optimizing the expected value of a single-objective function representing the performance of a reservoir system with stochastic inflows is discussed. General approaches for its solution are reviewed and their limitations are discussed. In general, the problems of statistical forecasting and optimization are coupled and cannot be separated without loss of optimality. There are, however, particular classes of optimization problems, called certainty equivalent, for which the present optimal operation is indifferent to future uncertainty. For such systems it is appropriate to decouple stochastic estimation from control and use the best projections of real-time forecasting schemes in series with deterministic optimization. For known system and measurement dynamics, an operation problem is certainty equivalent if there is no need for 'caution' or hedging. From the viewpoint of applications the concept of caution is fundamental to the extent that optimization problems appearing in reservoir operation problems may be distinguished into certainty equivalent and caution-dominated. Discussion and examples are presented to provide some insight into the interaction between uncertainty in forecasting and optimization and the effect of this interaction on the selection of an appropriate method of solution.
W83-03323

FLOOD CONTROL EFFECTIVENESS OF SYSTEMS OF DUAL PURPOSE DETENTION BASINS,
New Jersey Dept. of Environmental Protection, Trenton.
W. Whipple, Jr, S. D. Faust, W. Renwick, and N. K. Wiegand.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-223032, Price codes: A03 in paper copy, A01 in microfiche. Center for Coastal and Environmental Studies Completion Report, Rutgers - The State Univ. of New Jersey, New Brunswick, January 1983. 33 p, 3 Fig, 9 Tab, 10 Ref. OWRT B-084-NJ(3), 14-34-0001-1246.

Descriptors: *Flood control, Sedimentation, *Urban runoff, Model studies, Biochemical oxygen demand, Design criteria, *Dual purpose detention basins, Water pollution control, Bacteria, Heavy metals, Suspended solids, phosphates, Hydrocarbons.

Modeling was conducted of the passage of 2-, 10-, and 100-year mean frequency floods through detention basins designed in accord with various design criteria. Basins included were those with the additional purpose of removing particulate pollution. Results showed that the requirement to retain particulate pollution adds little to the storage needed to prevent past development increases in flooding from various sizes of design criteria for flood control and for alleviation of channel erosion tendencies. One of the research objectives was to make a more definitive determination of the relationship between pollutant settleability of runoff as observed in the laboratory and in the actual basin. It was concluded from these laboratory and field studies that substantial quantities of BOD sub 5,20, suspended solids, total phosphates, total hydrocarbons, and six heavy metals are removed by simple sedimentation. Fecal coliforms and total organic carbon are not reduced significantly by plain sedimentation.
W83-03350

CURRENT STORMWATER DRAINAGE PRACTICE IN SOUTH AFRICA,
M. D. Watson, and L. C. Miles.
Civil Engineer in South Africa, Vol 24, No 6, p 251-253, 255-257, June, 1982. 6 Fig, 6 Tab, 14 Ref.

Descriptors: *Stormwater, *Design criteria, Water management, *Drainage, *Flood control, Engineering, Storm runoff, Rainfall-runoff relationships, Storms, *South Africa.

A survey of current stormwater drainage design practices by the National Building Research Institute was made during 1979. Questionnaires were sent to various design offices in the Republic of South Africa. Questions concerned design philosophy, design storm recurrence intervals, frequency of observed malfunctions, hydrological design methods, and minimum allowable pipe diameters. An example of a design for a hypothetical urban subdevelopment was also requested. The results indicated a common design philosophy throughout the country but highlighted wide variations in the application of design techniques. The traditional drainage design philosophy of disposing of runoff in the most rapid way available is the method most commonly applied. The more recent philosophy incorporating the concepts of minor and major systems, although not unknown, has not become common design practice. There are wide differences of opinion on the amount of flood protection needed for a given type of development. Designers are generally of the opinion that a drainage system performs as it is designed to perform. The Rational Method of flood prediction was the most commonly used technique for sizing stormwater drainage pipes. Computer methods are not commonly used for urban flood prediction, and modern stormwater drainage computer models are also used infrequently. Flood prediction should be based on a sound understanding of the rainfall-runoff process. The need for local runoff data is essential to further our knowledge and experience. (Baker-FRC)
W83-03387

A PUBLIC PARTICIPATION DECISION TO FILL A PACIFIC NORTHWEST RESERVOIR,
Army Engineer District, Portland, OR.
For primary bibliographic entry see Field 6D.
W83-03423

MANAGING FOR WAVES ON NEBRASKA'S LAKE MCCONAUGHY - AN OVERVIEW,
Nebraska Water Resources Center, Lincoln.
For primary bibliographic entry see Field 8A.
W83-03426

INVESTIGATION INTO EFFECTIVE CONTROL METHODS FOR BRAZILIAN ELODEA (EGERIA DENSA PLANCHON) IN LAKE MARION, S.C.,
Clemson Univ., SC. Dept. of Botany.
C. R. Dillon, and K. D. Getsinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224477, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Publication No 103, Clemson Univ., S.C., May 1983. 85 p, 7 Fig, 7 Tab, 18 Ref, 1 Append. OWWR B-124-SC(1), 14-34-0001-9132.

Descriptors: Aquatic plants, *Aquatic weed control, *Biomass, *Brazilian elodea, *Carbohydrates, Carbon, *Carbon radioisotopes, *Egeria densa, *Starch benthic flora, Lake Marion, Life history studies, Plant populations, Population dynamics, Rooted aquatic plants, Submerged plants, Weed control, Weeds, *South Carolina.

Biomass production, morphological and physiological phenomena were followed in various plant parts to determine periods of quiescence, growth and senescence in the life cycle of Egeria densa Planchon (Brazilian elodea) in Lake Marion, South Carolina, from March, 1980 to May, 1981. Physicochmical parameters were also measured during 1978 to 1979. Major growth flushes occurred in spring and fall. Each of these flushes were followed by periods of senescence, denoted by decline in physiological activity and loss of biomass through sloughing and decay of tips and branches. A period of quiescence was observed in winter, denoted by limited physiological activity and no loss of biomass. Maximum biomass occurred in July. Minimum biomass occurred in March. Late summer-early fall senescence occurred during periods of elevated water temperatures. Greatest super 14C assimilation occurred from April through July, and least assimilation occurred in August and January. Amylase activity was greatest in most plant parts during spring, decreased in summer and increased again in fall. Greatest levels of amylase activity occurred in stems and rootcrowns. Starch concentration was inversely proportional to amylase activity, with the highest starch levels occurring in summer and the lowest occurring in winter and early spring. Greatest starch concentrations were found in stems and rootcrowns.
W83-03433

4B. Groundwater Management

INVESTIGATIVE PROGRAMS FOR DESIGNING AND MODELING MINE WATER CONTROL SYSTEMS,
International Engineering Co., Inc., San Francisco, CA.
L. C. Venburg, D. Sokol, and M. V. Damm.
Mining Engineering, Vol 34, No 8, p 1217-1219, August, 1982. 6 Fig, 3 Ref.

Descriptors: *Mine drainage, Model studies, *Dewatering, *Groundwater management, *Hydrologic models, *Aquifer management, *Mining engineering, Groundwater movement, Injection wells, Recharge wells, Aquifer characteristics, Water management.

The uses of models predicting groundwater inflow and the impact of dewatering and stream diversion are described. Geohydrologists and engineers use various models to optimize handling of surface and groundwater during mining operations. In addition, the initial and long-term impacts of mining and dewatering can also be predicted by modeling. Models should be based on extensive and cumulative hydrologic and geologic data on the site in question and similar mining areas. Ideally, these data should cover aquifer properties and conditions (confined, semiconfined or unconfined), potentiometric surface or water table information, aquifer recharge, groundwater movement, natural discharge and water quality data. A conceptual groundwater model which incorporates these factors was constructed for a mine between two tributary streams. The model includes the hydrologic boundary conditions based on a field investigation program. The edge modes of the model are set as no-flow, constant flux or constant head boundaries, depending on recharge conditions. Such a model should be useful in designing the water control system and determining the impact on the hydraulic regime. (Geiger-FRC)
W83-03265

AN ASSESSMENT OF THE USE POTENTIAL OF THE FLOW OF WATER AT THE SPRING 'OJO DE AGUA' IN AGUADILLA, PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of General Engineering.
N. Aneses, and A. Calderon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-221747. Price codes: A03 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute completion report, Mayaguez, June 1983. 29 p, 1 Append. OWRT A-072-PR(1). 14-34-0001-1141.

Descriptors: *Hydroelectric power, *Springs, Flow, *Puerto Rico, Aquadilla.

The objective of this study was to determine the potential uses which could be given to the water emerging from a small spring located within the urban zone of the town of Aguadilla, in Puerto Rico. It was found that the spring produces 766 gallons per minute during the island's dry season and 1,324 gallons per minute during the rainy season. The minimum amount of electricity which could be generated from the spring was determined to be 283 watts if a mini-hydroelectric plant were placed in it. This would be enough to provide adequate illumination for a passive-recreation park located next to the spring. (R. Munoz)
W83-03321

MONITORING OF GROUNDWATER LEVELS FOR REAL-TIME CONJUNCTIVE WATER MANAGEMENT,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7B.
W83-03333

EVALUATION AND ACCESSING OF DATA FOR A WATER RESOURCES SIMULATOR,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7A.
W83-03334

EFFECTS OF GROUNDWATER PUMPAGE ON SURFACE AND GROUNDWATER FLOWS ON ADJOINING BASINS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
E. S. Simpson, U. Kafri, and J. H. Randall.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224451, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Tucson, Arizona, June 1983. 40 p, 14 Fig, 9 Tab, 30 Ref. OWRT A-070-ARIZ(1). 14-34-0001-6003.

Descriptors: Groundwater, *Groundwater depletion, *Arizona, Cienega Basin, *Groundwater recharge, *Aquifer models, *Withdrawals, Model studies.

The consequences were examined of possible future large-scale groundwater withdrawals from Cienega Basin, located about 40 miles southeast of Tucson, Az. The basin lowland consists of alluvial deposits up to 2,000 feet thick, surrounded by fractured rocks that rise to more than 5,000 feet above the lowland. Total drainage area is 303 mi super 2. Average annual ppt. is 17 in. Average annual recharge to groundwater calculated by an infiltration method is 19,500 acre-feet; calculated by a salt balance method it is about 15,700 acre-feet calculated by model calibration it is about 10,700 acre-feet. Model studies show that if future pumpage is 14,000 acre-feet/year, and assuming a storage coeff. of 0.01, at the end of 20 years the cone of depression will affect virtually the entire basin and encroach on adjoining basins. If the storage coeff. is assumed to be 0.10, the cone of depression will be confined to the lowland areas. Long-term value of the storage coeff. is believed to be equal to or greater than 0.10.
W83-03431

AN ECONOMIC ANALYSIS OF OBSTACLES TO WATER CONSERVATION IN MONTANA WATER LAW,
Montana State Univ., Bozeman. Dept. of Agricultural Economics and Economics.
R. Stroup, and A. Vinnard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-226845, Price codes: A04 in paper copy, A01 in microfiche. Montana Water Resources Research Report No 131, Montana State Univ., Bozeman, June 1983. 42 p, 4 Tab, 9 Fig, 6 Ref. OWRT A-130-MONT(1), 14-34-0001-1128.

Descriptors: *Groundwater resources, *Artesian aquifers, *Cost analysis, Linear programming, Dynamic programming, Pumping, Energy, Water law, Water conservation, Groundwater management, Groundwater policy, Land productivity, Sensitivity analysis, True costs, Temporal allocations, *Montana, Crow Creek.

This study examines groundwater management in Montana. State groundwater law is reviewed and various management approaches are briefly evaluated. A case study using linear and dynamic programming is made of the Crow Creek Valley in Southwestern Montana to demonstrate the use of an optimization model in determining the most efficient temporal allocation of groundwater. Results of the analysis indicate that when groundwater systems are confined, there is a decided economic advantage in maintaining the artesian

pressure in the system by not exploiting the stock component of the resource. Marginal pumping costs rise rapidly when groundwater is extracted from a confined system. If stocks are depleted to the point where the piezometric surface falls below the confining stratum, the system becomes unconfined and the artesian pressure is lost. If stocks continue to be depleted beyond this level, eventually the system moves to a second equilibrium state. Sensitivity analysis is used to examine the impact of changes in the discount rate, size of the basin, energy costs, and land productivity on the derived decision rule. Energy costs have the greatest impact on the general structure of the optimal use policy. The results of the case study point out the benefits from an optimal groundwater policy. Recommendations are made for further study.
W83-03464

CALIFORNIA GROUNDWATER MANAGEMENT: THE SACRED AND THE PROFANE,
John Muir Inst., Berkeley, CA. Center for National Resource Studies.
For primary bibliographic entry see Field 6E.
W83-03498

4C. Effects On Water Of Man's Non-Water Activities

ASSESSMENT OF STORMFLOW AND WATER QUALITY FROM UNDISTURBED AND SITE PREPARED FOREST LAND IN EAST TEXAS,
Texas A and M Univ., College Station. Water Resources Inst.
M. G. DeHaven, W. H. Blackburn, J. L. Nieber, W. W. Crawley, and A. T. Weichert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219816, Price codes: A07 in paper copy, A01 in microfiche. Completion Report No 122, January 1983. 125 p, 46 Tab, 40 Ref, 2 Append. OWRT A-049-TEX(1), 14-34-0001-0146,1146,2146.

Descriptors: Sediments, Nutrients, Nonpoint pollution sources, *Forest practices, Water quality, Watersheds, Biomass, Clearcutting, Shearing, Windrowing, *Texas, Stormflow, *Forest watersheds, Lumbering.

Nine small forested watersheds were instrumented in 1979 to determine the effect of intensive forest management practices on water quantity and quality. During 1981, the first year after treatment, stormflow volumes, sediment and nutrient losses increased with the intensity of the site disturbance. Sites sheared produced the greatest amount of stormflow, sediment and nitrate losses, followed by chopped and the undisturbed watersheds. Stormflow volumes, sediment and nitrate decreased on the sheared and chopped watersheds substantially the second year following treatment. The rapid vegetation and reduction in exposed mineral soil that occured on both sheared and chopped treatments during 1982, resulted in a decrease in runoff and sediment and nutrient losses. Limiting shearing and windrowing activities to the more gentle slopes will reduce first year erosion and prevent increases in sediment and nutrient losses. Roller chopping on the other hand, appears to cause only minor changes to water yield and quality on slopes of up to 25%.
W83-03277

4D. Watershed Protection

SOIL CONSERVATION AND WATER QUALITY IMPROVEMENT: WHAT FARMERS THINK,
Georgia Univ., Athens. Dept. of Agricultural Economics.
L. A. Christensen, and P. E. Norris.
Journal of Soil and Water Conservation, Vol 38, No 1, p 15-20, January-February, 1983. 40 Ref.

Descriptors: *Soil conservation, *Water quality, *Farming, Public opinion, Government supports, Erosion control, Soil erosion.

A review is offered of farmers' attitudes about the control of nonpoint pollution through soil conservation and other measures. While generally believing that soil erosion and water quality degradation are problems, farmers hesitate to admit that there is any relationship between their land and the national erosion problem. Farmers may be hesitant to recognize the problems and install conservation practices because of limited knowledge. The perceived effectiveness of a conservation practice will greatly influence a farmer's choice of a practice once he decides to implement a conservation program. Differing perceptions of the effectiveness of the conservation practices can be attributed to variations in both information about and experience with the practice. Perceptions of risks related to yields and income levels also influence a farmer's decision. Perceptions of benefits may also prevent farmers from initiating conservation programs. Apparently there is some question about the profitability of using conservation practices. Attitudes toward government involvement, personal characteristics, institutional characteristics, physical characteristics, and policy implications each in their own way influence the farmer's acceptance of soil conservation measures. (Baker-FRC)
W83-03161

EFFECTS OF INCREASED PRECIPITATION AND GRAZING MANAGEMENT ON NORTHEASTERN MONTANA RANGELANDS,
Geological Survey, Denver, CO. Water Resources Div.
F. A. Branson, and R. F. Miller.
Journal of Range Management, Vol 34, No 1, p 3-10, January, 1981. 7 Fig, 2 Tab, 29 Ref.

Descriptors: *Precipitation, *Land management, *Range management, Farm management, Vegetation, Watersheds, Moisture availability, Vegetation establishment, *Montana.

Fifteen plant communities on public lands in the Willow Creek basin near Glasgow, Montana were sampled in 1960 and again in 1977 to determine possible vegetation changes, Most of the communties demonstrated remarkable improvement in ground cover and forage production. Factors which contributed to these changes included: higher precipitation during the period between the first and second sampling than had been noted during the 10 year period prior to the first samples, and improved management practices such as land treatments and application of rest-rotation grazing systems. These finding conflict with the generally held opinion that the western rangelands are deteriorating. (Baker-FRC)
W83-03174

WATER QUALITY TRANSMISSION AND RUNOFF FROM EASILY CRUSTED ERODABLE SOILS AND MINE SPOILS. EFFECTS OF IN-SITU CROSSLINKABLE OIL TREATMENTS,
North Dakota State Univ., Fargo. Dept. of Chemistry.
P. Pappas, and J. Richardson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219733, Price codes: A08 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State University, Fargo, January 1983. 147 p, 31 Fig, 18 Tab, 130 Ref. OWRT B-056-NDAK(1), Matching Grant.

Descriptors: *Polymers, *Soil stabilization, Soil physical properties, Soil chemical properties, Soil structure, Soil texture, Erosion control, Chemical properties, Chemical reactions, *Soil treatment, Water quality, Runoff, Polyvinyl alcohol, Organic matter, Mine spoils.

Part I: A variety of two-phase, cross-linking polymers were tested and compared to polyvinyl alcohol as a treatment for soils. From these tests knowledge which cross-linking polymers have the greatest potential for use and the kinds or organic functional groups which promote aggregation most effectively. It was found that the traditional aggregate assessment methods yield little information about the bonding mechanisms that were occurring. Part II: Bonding mechanisms and mineral surface bonding strength were examined in order to obtain an understanding which would allow for development of better polymer types. The cross link polymers were synthesized from aldehyde and amine monomers. Existing literature suggests that amine should be added first to the soil and then the aldehyde added later to create the crosslinked in situ polymer. However, the rapid rise in soil pH that occurs when amines are added first creates organic matter destabilizaton. Therefore, aldehydes should bind first with the soil and the amines be added later for in situ cross-linking. The project has produced several new polymer materials. The in situ cross-linking polymers were not effective as amendments in these tests but the important functional groups have been identified and more effective polymers can be created in the future.
W83-03269

ASSESSMENT OF STORMFLOW AND WATER QUALITY FROM UNDISTURBED AND SITE PREPARED FOREST LAND IN EAST TEXAS,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 4C.
W83-03277

CONSERVATION OF SOIL, WATER, ANDD ENERGY THROUGH REDUCED TILLAGE SYSTEMS - PHASE I SUB 1,
Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
E. C. Dickey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220012, Price codes: A05 in paper copy, A01 in microfiche. Nebraska Water Resources Center Completion Report, Univ. of Nebraska, Lincoln, June 1983. 65 p, 11 Fig, 26 Tab, 31 Ref. OWRT B-052-NEB(1), 14-34-0001-0229.

Descriptors: *Soil erosion, *Soil conservation, *Erosion control, *Cultivation, Sedimentation, Soil management, Runoff, Precipitation, Mulching, *Nebraska, *Tillage systems, Simulated rainfall.

Soil erosion and sedimentation have been identified as major water quality problems in Nebraska. This project was initiated in 1980 to evaluate and demonstrate the influence of selected tillage systems on soil erosion, water runoff, nutrient loss, crop yield, fuel and energy use, and labor inputs. Tillage plots were established at two sites having different soil types and field slopes. Simulated rainfall, applied at the rate of 2.5 inches per hour, showed that soil erosion increased as the amount of residue remaining on the soil surface decreased. No-till planting, which left the highest percentage of soil surface covered with residue, resulted in the least amount of erosion, whereas the moldboard plow system has the most erosion. As little as a 20% residue cover reduced erosion by 50 percent of that which occurred from cleanly tilled, residue free soil conditions. Reducing or eliminationg field operations also decreased fuel use and labor requirements for tillage and planting. No-till had fuel and labor requirements 75 and 50 % lower, respectively, than the moldboard plow system, When cultural energy inputs were considered, no-till still used 10 % less total energy than the moldboard plow system, even though pesticide use was higher with no-till. Simulated rainfall was effective for demonstrating differences in erosion from various tillage systems.
W83-03287

THE COSTS AND BENEFITS OF SOIL EROSION CONTROL IN THE NORTH LAKE CHICOT WATERSHED,
Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
R. N. Shulstad, C. T. Osborn, and A. D. McQueen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222208, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 95, Univ. of Arkansas, Fayetteville, March 1983. 49 p, 1 Fig, 4 Tab, 8 Ref. OWRT A-056-ARK(2), 14-34-0001-2104

Descriptors: *Arkansas, *Soil erosion, *Watershed management, Farm management, *Soil conservation, *Lake basins, Surface water, *Economic feasibility, *Cost-benefit analysis, *Recreation demand, Lake Chicot.

Lake Chicot is divided by a levee into two basins, the high quality northern basin and the extremely polluted southern basin. Water quality in the northern basin of Lake Chicot is diminishing due to soil erosion. Costs for alternative control programs for the seventeen farm, 11,470 acre northern watershed were estimated. Twenty-nine combinations of rotations and best management practices were evaluated. Soil loss can be reduced almost 25% from 4.2 tons per acre to 3.2 tons per acre, while increasing net returns to farmers from $83.94 per acre to $107.28 per acre by altering present cropping patterns. A prohibition on fall plowing would result in an average net return of $106.28 per acre and reduce average soil loss to 2.9 tons per acre. An average soil loss restriction would be the most cost-effective policy, exclusive of administrative costs. Benefits of erosion control were estimated by the difference between the value of recreational participation on the northern basin and the value for the southern basin. Controls programs were highly cost-effective.
W83-03331

LARGE ORGANIC DEBRIS AND ANADROMOUS FISH HABITAT IN THE COASTAL REDWOOD ENVIRONMENT: THE HYDROLOGIC SYSTEM,
California Univ., Santa Barbara. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2E.
W83-03335

SOIL CONSERVATION AND THE REDUCTION OF EROSION AND SEDIMENTATION IN THE COON CREEK BASIN, WISCONSIN,
Geological Survey, Columbus, OH. Water Resources Div.
S. W. Trimble, and S. W. Lund.
Available from Br. of Distr., USGS, 604 S. Pickett St., Alexandria, VA 22304, Price $2.75. Geological Survey Professional Paper 1234, 1982. 35 p, 22 Fig, 7 Tab, 44 Ref, 3 Append.

Descriptors: Soil conservation, *Soil erosion, *Land management, *Sedimentation, Deposition, Sheet erosion, Rill erosion, Land use, *Wisconsin, Coon Creek basin, Driftless area.

The Coon Creek basin, in the Driftless Area of Wisconsin, has been strikingly transformed by soil conservation measures since the 1930's. Comparison of sheet and rill erosion by use of the Universal Soil Loss Equation, shows 1975 erosion rates on upland fields to be about one-fourth those of 1934. Average annual sedimentation accumulation in small reservoirs declined from about 5,000 megagrams per square kilometer in 1936-45 to about 50 megagrams per square kilometer in 1962-75. Analysis of deposition in tributary valleys suggests that annual rates declined from about 3,700 megagrams per square kilometer in the 1930's to about 35-70 megagrams per square kilometer in recent years. These reductions in erosion and sedimentation are due principally to improvements in land management and, to a lesser degree, to changes in land use. (USGS)
W83-03356

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

IMPROVED SALMONELLA RECOVERY FROM MODERATE TO HIGHLY POLLUTED WATERS,
Valencia Univ. (Spain). Dept. of Microbiology.
E. Alcaide, J. P. Martinez, P. Martinez-Germes, and E. Garay
Journal of Applied Bacteriology, Vol 53, No 2, p 143-146, October, 1982. 4 Tab, 21 Ref.

Descriptors: *Pollutant identification, *Salmonella, *Separation techniques, *Culturing techniques, *Culture media, Enteric bacteria, Enrichment, Antibiotics, Sewage bacteria, Pathogenic bacteria.

A new enrichment procedure for the recovery of Salmonella from aquatic environments is described. The new method consists of adding sodium novobiocin to a modified Rappaport's medium (NR10/43 degrees). The new Salmonella enrichment procedure was tested on water samples from a eutrophic lake (Albufera Lake, near Valencia, Spain) with moderate to high levels of fecal contamination and on samples of effluent entering a wastewater treatment plant. Statistical analysis of variance was used to compare the present method with other enrichment procedures. Results showed that the new medium offered a better recovery of Salmonella from water than selenite broth enrichment procedures and a simplification of the overall procedure. (Geiger-FRC)
W83-03164

DEUTERIUM AS A TRACER IN THE GROUNDWATER STUDY OF A CENTRAL NORTH DAKOTA MINING AREA,
North Dakota State Univ., Fargo. Dept. of Chemistry.
W-J. Hwang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-212019, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, North Dakota State University, Fargo, January 1983. 68 p, 14 Fig, 1 Tab, 43 Ref, 8 Append. OWRT A-075NDAK(1), 14-34-0001-2136.

Descriptors: *Groundwater, *Deuterium, *Mass spectrometry, *Strip mines, Infiltration, Precipitation, Surface water, Surface-groundwater interaction, Analytical methods, *North Dakota, Pollutant identification.

As part of a joint project designed to evaluate the impact of surface mining and reclamation on groundwater and surface water quality and quantity, the hydrogen isotope contents of water samples from two central North Dakota study areas have been analysed using mass spectrometric method. Five microliters of water samples were quantitatively converted into hydrogen gas. They were then analyzed with a double-inlet Nuclide mass spectrometer. Precipitations in the study area had deuterium content ranging from -17% for a rain sample, to -206% for a snow sample. Surface water samples had a mean deuterium content of about -80% with apparent seasonal variation and evaporative effect. Groundwater samples taken from undisturbed area (Falkirk area) had a mean deuterium content of about -120%, showing little evaporation or seasonal variations. From the deuterium data as well as oxygen-18 data, the groundwater sample taken seems to be recharged from local precipitation. Part of the groundwater samples taken from Center Mine area (disturbed setting) showed evaporative effects, which might be related to the exposure to atmosphere as a result of mining. Samples taken near or inside waste disposal sites also showed distinctive deviation from meteroic water line.
W83-03177

DETERMINATION OF THE COMPLEXING CAPACITY OF WATER SYSTEMS BY GEL CHROMATOGRAPHIC AND ELECTROCHEMICAL TECHNIQUES,
North Dakota Univ., Grand Forks. Dept. of Chemistry.
D. E. Bartak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-214957, Price codes: A03 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State University, Fargo, January 1983. 41 p, 10 Fig, 41 Ref. OWRT B-057-NDAK(1).

Descriptors: *Reticulated vitreous carbon electrode, *Metal complex separation, Modified gel permeation chromatography, *Electrochemical flow cell, *Chromatography, Copper complexes, Water analysis, Trace metals, Pollutant identification, Organic acids, EDTA, Polyamiocarboxylic acid, Ligands.

Part I: An electrochemical flow cell has been developed using reticulated vitreous carbon (RVC) coated with a thin film of mercury. The flow cell and electrode components are inexpensive and easily constructed. Reproducible results have been obtained for centrations as low as 100 ppb. Peak currents were dependent on flow rate, electrode size, and mercury deposition time. Oxygen interference was reduced by nitrogen purging to enable analysis of sub-ppm metal concentrations. The cell was tested as a detector for metal complexes eluated from a modified gel permeation chromatographic column. Part II: A modified gel permeation chromatographic technique using eluent which is buffered with copper(II) is used to separate a series of copper(II) complexes. An electrochemical flow cell is used to identify and quantitate the copper complexes; a reverse pulse amperometry mode is used to minimize oxygen interferences. A Sephadex G-25 column is used to resolve a mixture of polyaminocarboxylic acids. The detection limit for EDTA which is quantitified as the Cu-EDTA complex is found to be 12 microgram. A series of amino acids and organic carboxylic acids are tested with the above techniques. All of the above ligands except tyrosine are separated via size exclusion with a common depleted metal trough in the chromatographs.
W83-03185

MOLECULAR SIZE DETERMINATION OF CHLOROFORM PRECURSORS,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
J. L. Schnoor.
Iowa State Water Resources Research Institute, Publication No 109, Iowa State University, Ames, January 1983. 45 p, 1 Append. OWRT A-072-IA(2), 14-34-0001-0117.

Descriptors: *Organic compounds, River, Chlorination, Chemical composition, *Water treatment, Design criteria, *Molecular weight, *Trihalomethanes, *Organic carbon, *Chromatography, *Pollutant identification, Gel permeation chromatography, Iowa River, *Iowa.

The trihalomethane (THM) yield on a total organic carbon (TOC) basis was measured as a function of the molecular weight of precursor organics in the Iowa River. Gel permeation chromatography with Sephadex G-75 gel was utilized to separate naturally occurring organics into apparent molecular weight fractions that were subsequently chlorinated to 2 mg/L of free residual and analyzed for THMs. Ninety percent of the organics in the Iowa River were of mol wt less than 3000, while 75% of the THMs were derived from the mol wt less than 3000 fraction. Precursor organics were greatest during the months May-August. A packed-bed, countercurrent stripping tower was utilized to remove THM and other volatile organics from water. Design equations were developed.
W83-03187

FLUORIMETRIC DETERMINATION OF CHLOROFORM IN DRINKING WATER,
Kyoto Univ. (Japan). Faculty of Pharmaceutical Sciences.
K. Okumura, K. Kawada, and T. Uno.
Analyst Vol 43, No 6, p 1498-1502, 1982. 4 Fig, 5 Tab, 6 Ref.

Descriptors: *Water analysis, *Chloroform, *Fluorometry, Drinking water, Potable water, Trihalomethanes, Water quality, *Pollutant identification.

Chloroform gives a blue fluorphore when heated with nicotinamide and concentrated sodium hydroxide solution. This has been used to develop a new method which enables chlorform to be determined in water at the nanogram per milliliter level.

The blue fluorescence has an excitation maximum at 372 nm and an emission maximum at 467 nm. A linear relation was obtained between the concentration of chloroform and fluorescence intensity. The slopes of the calibration lines are dependent on the concentration of nicotinamide. The solution containing 20% m/v nicotinamide gave the maximum slope, that is, the maximum sensitivity to chloroform. The heating time of 3.0 minutes, which gives maximum and stable fluorescence intensity, was adopted for the present study. The average recovery of chloroform from water was excellent. This method is specific to trihalomethanes and is insensitive to other polyhalogen compounds. Sodium thiosulfate, added to remove residual chlorine from water samples, did not interfere in the determination of chloroform. (Baker-FRC)
W83-03190

DETERMINATION OF TOTAL IODINE AND IODATE-IODINE IN NATURAL FRESHWATER,
Institute of Hydrology, Wallingford (England).
S. D. Jones, C. P. Spencer, and V. W. Truesdale.
Analyst, Vol 43, No 6, p 1417-1424, 1982. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Iodine, Surface waters, *Water analysis, Iodate-iodine, Catalysts, Catalytic method, Pollutant identification.

The procedures for the determination of iodate, iodide and total iodine at concentrations between 0 and 5 micrograms/liter in freshwater are described. The procedures rely on the catalytic determination of iodide using the reaction between ammonium cerium(IV) sulfate and arsenious acid. Whereas total iodine is determined directly by a modification of an earlier procedure, iodate is determined after solvent extraction of iodide-iodine as an ion pair with the tetraphenylarsonium cation. It is also demonstrated that a catalytic method can be rigorously modified so as to satisfy new requirements. The analysis of sets of 11 replicate samples showed that the total iodine concentration could be resolved to within 0.1 microgram/liter at the 95% confidence level. The effect on the methods of various substances that could be present in the freshwaters is described, together with tests conducted upon some organic iodine compounds. The unsuspected presence of organic compounds would create problems. Analysis for total iodine can be conducted at the rate of about 50 samples per hour and that for iodate-iodine at about 20 per hour. (Baker-FRC)
W83-03206

ACCURACY OF DETERMINATION OF TOTAL OXIDISED NITROGEN AND NITRITE IN RIVER WATERS: ANALYTICAL QUALITY CONTROL IN THE HARMONISED MONITORING SCHEME.
Water Research Centre, Marlow (England).
Analyst, Vol 43, No 6, p 1407-1416, 1982. 7 Tab, 7 Ref.

Descriptors: *Water analysis, *Nitrogen, *Quality control, Nitrates, Rivers, Laboratories, Research facilities, *Nitrites, *Pollutant identification.

A collaborative study was performed on the determination of total oxidized nitrogen and nitrite in river waters. Each of the 11 participating laboratories achieved total errors of not greater than 20% of the determined concentration or 0.1 mg/1 of nitrogen (whichever was the larger for different sample concentrations). The success of the work was attributed to the suitability of the analytical methods adopted by the laboratories and the sequential approach followed in the analytical quality control program. The latter involves a relatively large amount of work in each of the participating laboratories, and a relatively long period is needed to complete all tests. However, these very factors provide many opportunities for unsuspected errors to reveal themselves, thereby facilitating recognition and elimination of problems so that a permanently sound basis is established for routine achievement of the required accuracy. Since most laboratories used modifications of the same analytical procedure (the Griess-Ilosvay spectrophotometric technique) the interlaboratory bias tests do not provide a direct check on absolute bias in river samples, merely on bias with respect to the mean result of many laboratories. Where laboratories use analytical methods based on different principles there is less likelihood of systematic errors caused by the choice of a single analytical method. In this case the mean result of many laboratories is more likely to correspond closely with the true value of determined concentration, and hence the inter-laboratory bias tests will provide a measure of absolute bias. (Baker-FRC)
W83-03207

EFFECT OF SUNLIGHT ON ENUMERATION OF INDICATOR BACTERIA UNDER FIELD CONDITIONS,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. S. Fujioka, and O. T. Narikawa.
Applied and Environmental Microbiology, Vol. 44, No 2, p 395-401, August, 1982. 2 Fig, 1 Tab, 16 R. OWRT A-053-HI.

Descriptors: *Bacterial analysis, *Sample preservation, *Radiation, *Pollutant identification, Water analysis, Wastewater analysis, Coliforms, Streptococci, Sampling, Bactericides, Microbiological studies, *Bioindicators.

The bactericidal effect of sunlight on subsequent enumeration of fecal coliforms (FC) and fecal streptococci (FS) was studied using samples and sunlight conditions in Hawaii. Samples were raw sewage and raw sewage diluted (1:100) with seawater or clear stream water. Sample containers were made of clear glass or translucent polyethylene. These were exposed to strong sunlight or totally shielded from sunlight for 5, 10, 15, 20, 30, 60, and 120 min before assay by the standard membrane filtration method. Bacteria in raw sewage samples were not greatly affected by sunlight. However, in diluted samples the 90% inactivation times were: FC in sewage-seawater mixture, 13 min in glass and 17 min in polyethylene; FS in sewage-seawater mixture, 26 min in glass and 32 min in polyethylene; FC in sewage-streamwater mixture, 28 min in glass and 38 min in polyethylene; and FS in sewage-streamwater mixture, $>$ 120 min. Bacteria in samples filtered through a membrane were placed in petri dishes with growth media and exposed to sunlight for 5-30 min. FC concentrations were reduced by 99% after 10 min sunlight exposures, 99.9% after 15 min, and 100% after 20 min. These results were the same for undiluted and diluted samples. Neither cooling the agar in ice nor condensation of water vapor in the petri dishes inhibited the bactericidal action of sunlight. It is recommended that water and sewage samples be collected in dark brown containers and shielded from sunlight until sample enumeration. (Cassar-FRC)
W83-03291

NEW APPROACHES TO MEASURING TOTAL BACTERIAL POPULATIONS IN WATER SUPPLIES,
Delaware Univ., Newark. School of Life and Health Sciences.
D. S. Herson, and K. H. Baker.
Journal of the American Water Works Association, Vol 74, No 10, p 537-539, October, 1982. 1 Fig, 3 Tab, 25 Ref. OWRT A-028-DEL.

Descriptors: *Bacteria, *Water analysis, *Microbiology, *Pollutant identification, Bacterial analysis, Microbiological studies, Drinking water, Well water, *Delaware, Wilmington, Newark, *Water treatment.

Direct counts of stained bacterial cells were compared with standard plate counts in samples from a distribution system and private unchlorinated wells. The technique, AOINT, combined acridine orange (AO) staining with 2-(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride (INT) reduction. A gel stripping procedure was used to transfer the cells from the membrane filter to a gelatin matrix because the filter pores interfered with recognition of INT-formazan crystals. Plate count agar results and AOINT results were not significantly correlated. AOINT results were significantly higher than the standard plate count results. In well water samples, plate counts were 12-4800 CFU per ml; AOINT, 8000-55,000 cells per ml. In distribution water samples plate counts were 0-566 CFU per ml; AOINT, 300-10,000 cells per ml. The AOINT technique requires only 4 hours for determination. However, it identifies only the number of metabolically active bacteria, not the type. It is suggested as an adjunct to, not a replacement for, the standard plate count. (Cassar-FRC)
W83-03292

DEVELOPMENT OF A CELL CULTURE SCREEN FOR WATER TOXICITY,
Oklahoma State Univ., Stillwater. Dept. of Biochemistry.
F. R. Leach, S. R. VanDoren, L. B. Frazier, and M. S. Hall.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220533, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Oklahoma State Univ., Stillwater, March, 1983. 25 p, 2 Fig, 4 Tab, 4 Tab, 15 Ref, 2 Append. OWRT A-097-OKLA(1), 14-34-0001-1138.

Descriptors: *Bioassay, *Biochemical tests, *Metabolism, Pollutants, Water pollution, Oil refineries, *Oil pollution, Organic compounds, Inhibitors, Organic solvents, Radioactive tracers, Radioisotopes, Inorganic compounds, Acid streams, Mine drainage, *Toxicity tests, Pollutant identification, *Oklahoma, Tar Creek.

A technique for the rapid measurement of the toxicity of water samples to cells in culture has been developed. HeLa cells growing on microcarrier beads were incubated with 0.1 micro-Ci/ml of (super 3H)-thymidine and appropriate dilutions of the water sample in question. The beads with the attached cells were sedimented by centrifugation and treated with 10% trichloroacetic acid to precipitate DNA. The precipitate was dissolved by incubating with Soluene 350. The radioactivity in the samples was determined with a liquid scintillation counter and the percent inhibition for each sample was calculated based on laboratory glass distilled water as the control. The inhibition produced by hydroxyurea, m-cresol, ZnS0 sub 4, and environmental samples was determined. The method was applied to various samples of Tar Creek water and to refinery effluents from various refineries.
W83-03306

WATER QUALITY OF THE UPPER SPOKANE RIVER AND EVALUATION OF METHODS FOR MEASUREMENT OF THE EFFECT OF EFFLUENT UPON PRIMARY AND SECONDARY PRODUCERS,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
W. H. Funk, H. L. Gibbons, R. M. Duffner, T. Notestine, and T. Nielsen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-221705, Price codes: A07 in paper copy, A01 in microfiche. Water Research Center Publication No 48, Washington State Univ., Pullman, January 1983. 130 p, 40 Fig, 10 Tab, 84 Ref, 3 Append. OWRT A-105-WASH(1), 14-34-0001-1151.

Descriptors: Water quality, Management, Methodologies, *Periphyton, *Macroinvertebrate, Sampling, *Washington, Spokane River, Water pollution effects, Recharge, Zinc, Substrates, *Pollutant identification, Indicators, *Water quality control.

This investigation reviews the present state of water quality at ten stations on the Spokane River from the Washington - Idaho Stateline, River Kilometer 153 to the entry of Hangman Creek River Kilometer 117 below the City of Spokane. A major objective of the study was to supply water quality management information in the critical recharge area of the Spokane River. Other objectives were to develop and refine methodologies for obtaining representative periphyton and macroinvertebrate

samples and to investigate the effectiveness of several substrates for long term water quality indication. Nearly all physicochemical water quality indicators showed a measurable increase due to the addition of aquifer waters during the low flow period of the study. There was also a rise in dissolved constituents as the waters moved downstream most likely as a result of urban runoff and increased human activities along the river. Metal content was relatively low considering mining activities in the headwater regions. An exception was zinc which ranged from 5 to 225 micrograms per liter. Artificial and natural substrates are compared in periphyton studies. Optimum colonization periods are discussed. Sampling design deficiencies are reviewed and recommendations made. Certain aspects of direct sampling by suction sampler are discussed as well as bias introduced by the utilization of natural and artificial samplers for long term investigations. Placement of samplers and the use of basket and multiplate samplers are also discussed in the case of macroinvertebrate studies.
W83-03317

THE BIOTA OF OKLAHOMA SPRINGS: NATURAL BIOLOGICAL MONITORING OF GROUNDWATER QUALITY,
Oklahoma Univ., Kingston. Biological Station.
For primary bibliographic entry see Field 2H.
W83-03347

CHARACTERIZATION OF KEL-F-GRAPHITE COMPOSITE (KELGRAF) ELECTRODES AND APPLICATION TO DETECTION IN FLOWING STREAMS,
North Dakota State Univ., Fargo. Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W83-03369

ORGANICS TRANSPORTED THROUGH SELECTED GEOLOGIC MEDIA: ASSESSMENT OF ORGANICS TRANSPORTED AWAY FROM INDUSTRIAL WASTE DISPOSAL SITES,
Connecticut Univ., Storrs. Inst. of Water Resources.
J. D. Stuart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224246, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, April 1983. 20 p, 4 Fig, 5 Tab, 10 Ref, 1 Append. OWRT A-089-CONN(1), 14-34-0001-0107.

Descriptors: *Groundwater pollution, *Soil contamination, *Leachates, *Chemical wastes, *Organic compounds, Soil water, Soil envvironment, Connecticut, Ridgefield, *Pollutant identification, Gas chromatography, Wells, Chlorinated hydrocarbons, *Phenols, Extraction.

Batch extraction methods were used to determine the % removal of four organic chemicals from water. For the removal of phenol at the 90 ppm level, the following important parameters in the local soils were: pH, % clay and % organic matter. For the removal of 1,1,2-trichloroethylene at the 1.1 ppt level: % organic matter, cation exchange capacity, exchangeable basic cations and % clay were found to be important. The following soils in decreasing order were found to be able to remove a water-saturated chlorobenzene solution: muck, clay, then sand. Using purge-and-trap, GC/MS for the analysis 1,1,1-trichloroethane at the 0.30 ppm level in deionized water, the following soils in decreasing order were found effective in removing the chemical: muck, clay, top soil, and then sand. A field hydrogeologic investigation was conducted around an industrial plant located in the town of Ridgefield, Ct. Levels of purgeable halomethanes, one-to-ten times greater than the SNARL (E.P.A.'s - Suggested No Adverse Response Limit) were detected by purge-and-trap, gas chromatographic analyses of water samples taken from two of the nine wells monitored. The well having the highest halomethane levels was in an area known to have been used to store barrels containing used solvents from the metal degreasing process. The location of the second well, on the other side of the property, suggested a second area of contamination not previously recognized. An extended report was made available to state and local water quality authorities.
W83-03375

THE INFLUENCE OF SAMPLE TREATMENT ON NUTRIENT ANALYSIS IN EUTROPHIC WATERS (DER EINFLUSS DER PROBENBEHANDLUNG AUF DIE NAHRSTOFFANALYTIK BEI EUTROPHEN GEWASSERN),
G. Dudel, J. G. Kohl, and A. Nicklisch.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 5, p 489-493, 1980. 2 Tab, 15 Ref. (No English Summary).

Descriptors: *Water analysis, *Sample preparation, *Sample preservation, *Eutrophic lakes, *Nutrients, Water sampling, Nitrates, Orthophosphates, Ammonium, Filtration, Membrane filters, Paper filters, Plankton, Denitrification, Limiting nutrients, *German Democratic Republic.

The treatment of water samples from eutrophic lakes during transport and storage prior to analysis can significantly influence the results of analysis to determine limiting nutrient content. Unfiltered and filtered (through Synpor membranes) samples from the lakes Krebssee and Pehlitzsee (German Democratic Republic) were tested for nitrates and orthophosphate content. Great differences between results were found: e.g., for NO3(-), 11.4 and 13.4 micromol/l was found in unfiltered and filtered samples from Krebssee and Pehlitzsee, respectively, while corresponding figures for Pehlitzsee were 0.71 and 11.2 micromol/l for PO4(3-), unfiltered samples showed 1.93 (Krebssee) and 3.23 (Pehlitzsee) micromol/l, while filtered samples showed 0.12 and 0.33 micromol/l. Further samples from Pehlitzsee were treated in three ways: stored unfiltered at 4 CC for 36 hr, membrane filtration before analysis (1); membrane filtration immediately after sampling; after transportation (2 hr, 4 C), frozen at 17 C until analysis (2); as (2), but with additional paper filtration (3). Again, great differences according to sample treatment were seen, and rank variance analysis revealed that at least two mean values were significantly different for nitrate, ammonium, and orthophosphate determinations. The modified t-test showed that all three treatment variations differed significantly for nitrate analysis. Nitrate and ammonium contents were lowest in treatment (1), highest in (3), while orthophosphate contents varied widely. Nitrate reduction in the stored sample was attributed partly ti denitrification, while other variations were due to the influence of plankton on freenutrient content (through uptake, excretion, cell lysis or metabolic changes within the sample). The results showed that membrane filtration can eliminate or greatly reduce many interference factors in analysis by removing a large portion of particulate content; paper filtration is particularly advantageous. (Gish-FRC)
W83-03392

COPPER(II) COMPLEXING CAPACITIES OF NATURAL WATERS BY FLUORESCENCE QUENCHING,
New Hampshire Univ., Durham. Dept. of Chemistry.
D. K. Ryan, and J. H. Weber.
Environmental Science and Technology, Vol 16, No 12, p 866-872, December, 1982. 3 Fig, 3 Tab, 40 Ref.

Descriptors: *Copper, Surface waters, *Fluorescence quenching, *Complexing capacities, Humic acids, Water analysis, *Titration, *Pollutant identification.

The determination of complexing capacities (CL) values of natural water samples by Cu(2+) titrations using fluorescence and Rayleigh scattering were monitored. From this data CL values were calculated, and average conditional stability products were also determined. In addition various commonly measured water characteristics for the samples were correlated with each other and with the titration results in order to show statistically significant trends. The results indicate that the fluorescence technique directly measures only organic matter complexation, and CL values are unaffected by hydrolysis. Filtered water samples are analyzed at their natural pH under N2 but are otherwise unaltered. The onset of Rayleigh scattering signals the formation of a precipitate and was used to indicate a suitable stopping point for titrations. Scattering and fluorescence trends were similar for all samples except an estuarine sample. A multiple correlation study of several commonly measured water characteristics and the titration parameters showed a statistically significant trend between UV absorbance and CL values. (Baker-FRC)
W83-03396

LAGOON ALGAE AND THE BOD TEST,
P. R. Cosser.
Effluent and Water Treatment Journal, Vol 22, No 9, p 357-358, 360, 361, September, 1982. 2 Ref.

Descriptors: *Testing procedures, *Biochemical oxygen demand, *Algae, Wastewater treatment, Effluent limitations, Oxygen demand, Ponds, Oxidation ponds, Algal growth, Literature review, Lagoons.

The presence of high concentrations of carbonaceous and nitrogenous compounds in domestic sewage makes it an ideal medium for biochemical activity. However, the utility of BOD results derived from samples containing significant amounts of algae is questionable. Under test conditions the rate of oxygen consumption by algae is depressed due to deficiencies in the incubation medium, reduced respiration due to prolonged darkness, suppression of the release of organic excretory products, and survival of the cells so that degradation does not proceed. In all respects oxygen consumption is below that which will occur in the receiving environment, and therefore the use of BOD tests for the assessment of potential oxygen demand is invalid. The major source of error results from the fact that algae remain viable under test conditions, whereas they apparently die and are subsequently degraded in the receiving water. Stipulation of lagoon effluent guidelines and assessment of effluent quality in terms of COD rather than BOD would provide a far more credible foundation for water quality management. (Baker-FRC)
W83-03400

RADIOACTIVITY IN WATER FROM THE RIVER LEA,
North East London Polytechnic (England). Dept. of Applied Physics.
L. R. Day, and C. M. King.
Environmental Pollution, Series B Vol 5, No 1, p 1-8, 1983. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Potassium radioisotopes, *Radioactivity, Lea River, *United Kingdom, Radioisotopes, *Pollutant identification, Beta counting technique, Tritium.

Radioactivity found in the River Lea, United Kingdom, was attributed to naturally-occurring potassium radionuclides. Samples collected in 1979 and 1981 at 14 stations in the river and its tributaries showed very low levels of activity (maximum 15.6 pCi per liter of water, average 8.2 pCi per liter of water) as measured by the gross beta counting technique, which has an error of 20%. Average beta activity attributed to potassium-40 was 7.5 pCi per liter of water; no tritium was detected. These results indicate that no radioactive pollution is present in the river system. (Cassar-FRC)
W83-03401

A METHODOLOGY FOR ALGAL POPULATION STUDY OF PERIPHYTON: MEASUREMENT OF COVERING RATE (UNE METHODOLOGIE POUR L ETUDE DES POPULATIONS ALGALES DU PERIPHYTON: LA MESURE DU TAUX DE RECOUVREMENT),
Inha Univ., Incheon (Republic of Korea). Dept. of Biology.
B. -J. Yi.
Archiv fur Hydrobiologie, Vol 88, No 1, p 120-127, February, 1980. 3 Fig, 12 Ref. English summary.

Descriptors: *Microscopy, *Algae, *Population dynamics, *Population density, *Microscopic analysis, Algal growth, Aquatic populations, Water analysis, *Korea, Eutrophication, Aquatic productivity.

A methodology applicable to the quantitative and qualitative study of periphyton algal populations is presented. The method uses a glass microscope slide and consists of support frame settlement and substrate fixation, fixation and mounting of fresh material found on the collected substrate, and direct counting. Direct counting is carried out on treated substrata surfaces by adapting phytosociological methods and thus assessing each taxon's covering rate. The glass slide treatment consists of fixation in a mixed solution of 50% fixative and 50% glycerol, dehydration at 40 deg C, and sealing of the cover. For direct counting, the treated slide surface is examined under the microscope at 500 magnification. The number of squares in the optical field (200 squares in a 200 x 200 micrometer field) crossed by one individual taxon, unicellular or filamentous, is determined. The total covering rate of a taxon equals the total number of squares counted during 30 consecutive displacements of the optical field (0.04 sq mm x 30 times). Thus, the visualization of algal species which characterize a substrate or a sample is permitted. (Small-FRC)
W83-03407

POLAROGRAPHIC DETERMINATION OF LOW LEVELS OF CYANIDE AND METALS IN THE WASTE-WATERS DISCHARGED BY AN ELECTROPLATING PLANT (DOSAGES POLAROGRAPHIQUES DE FAIBLES QUANTITIES D'IONS CYANURE ET DE METAUX DANS LES EUAX REJETEES PAR UN ATELIER DE GALVANOPLASTIE),
Rouen Univ., Mont-Saint-Aignan (France). Lab. de Chimie Analytique.
A. Marechal, J. P. Salaun, and C. Caullet.
Analusis, Vol 9, No 7, p 333-339, 1981. 9 Fig, 4 Tab, 10 Ref. English summary.

Descriptors: *Cyanide, *Polarographic analysis, *Metal finishing wastes, *Electrochemistry, Water pollution, Toxicity, Chromium, Copper, Nickel, Industrial wastes, Zinc, Cadmium, Iron, *France, *Pollutant identification.

Alternating current and differential pulse polarography allow the direct titration of low levels of free cyanide (less than 0.1 mg/liter) in the wastewaters discharged by an electroplating plant. The sample must be preserved correctly. A polarographic peak appears for CN(-) in an ammonical medium if appropriate amounts of ethylenediamine and Cu(II) are present. Its electrochemical origin is discussed as the sum of an anodic and a cathodic process occurring at the same potentials. The cyanide concentration is determined by a three-point standard method. The conditions of preservation and analysis of the main toxic elements (Cr(IV), Cu(II), Ni(II), Zn(II), Cd(II), and total Fe) contained in the effluent were also investigated so that their simultaneous or successive determination can be performed by standard addition without interferences. Both polarographic techniques lead to the same sensitivity limits. (Author's abstract)
W83-03412

DETERMINATION OF PAH IN WATER AND SEDIMENTS BY LOW TEMPERATURE FLUORIMETRY (DOSAGE DES HYDROCARBURES AROMATIQUES POLYNUCLEAIRES DAN LES EAUX ET LES SEDIMENTS PAR FLUORIMETRIE A BASSE TEMPERATURE),
CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses (France).
B. Santoni, and C. Mandon.
Analusis, Vol 9, No 6, p 259-264, 1981. 12 Fig, 4 Tab, 14 Ref. English summary.

Descriptors: *Hydrocarbons, *Fluorometry, *Water analysis, *Sediments, Temperature, Drinking water, Rivers, Chemical analysis, Water pollution, Ultrasonics, Chromatography, *France, *Pollutant identification.

A procedure for the quantitative analysis of PAHs in environmental samples is presented. Low temperature fluorimetry with the Shpol'skii effect was the basic technique. Any of the six hydrocarbons chosen by the EEC as indicators of PAH contamination can be identified in a mixture containing all six hydrocarbons. The determination of each one of the six in a mixture is feasible. For river water or tap water analyses, PAHs are extracted by hexane, with a recovery factor of about 98-100% at concentrations of about 0.03-0.2 micrograms/liter. In river sediments, PAHs are isolated through ultrasonic extraction with DMSO. Compounds that would interfere in fluorimetric determinations are separated by hexane reextraction and chromatography on silica gel. The recovery rate for PAHs is about 90%. Three ng of BaP can be determined in 1 gram of sediment. (Author's abstract)
W83-03413

TRACE TOXIC METALS DETERMINATION IN NATURAL WATERS USING X-RAY FLUORESCENCE SPECTROMETRY ON A CHELATING RESIN CAPTOR (DETERMINATION DE TRACES METAUX TOXIQUES DANS LES EAUX NATURELLES PAR SPECTROMETRIE DE FLUORESCENCE X SUR CAPTEUR DE RESINE CHELATANTE),
Tours Univ. (France). Lab. de Chimie Minerale et d'Hydrologie.
F. Clanet, R. Deloncle, and G. Popoff.
Analusis, Vol 9, No 6, p 276-282, 1981. 3 Fig, 7 Tab, 35 Ref. English summary.

Descriptors: Zinc, Cadmium, Mercury, Lead, *X-ray fluorescence, X-ray spectroscopy, *Heavy metals, Water analysis, Chemical analysis, Toxicity, Sampling, Water pollution, *France, *Pollutant identification.

Zn, Cd, Hg, and Pb at sub-microgram/liter levels in natural waters are preconcentrated by filtration on a captor, which is a plastic cartridge containing Chelex-100 resin. After pelletizing the captor by hot pressing, metals are determined qualitatively and quantitatively by X-ray fluorescence spectrometry. The detection limit is 0.3 ppb for zinc, 0.8 ppb for cadmium, 0.8 ppb for mercury, and 0.2 ppb for lead. This procedure is useful in field studies for the fixation of toxic metal traces in water. Samples are obtained on a well-defined solid medium of small volume which is easy to transport. The sample can be analyzed using X-ray fluorescence spectrometry or by elution of toxic metals for analysis in solution by atomic spectrometry or by polarography. (Author's abstract)
W83-03414

INVERSE-VOLTAMMETRY OF SOME COPPER CHELATES USING A CARBON PASTE ELECTRODE. DETERMINATION OF COPPER IN DRINKING WATER BY OXIDATION OF COPPER DITHIO-OXAMIDE (ZUR INVERS-VOLTAMMETRIE EINIGER KUPFERCHELATE AN DER KOHLEPASTE-ELECTRODE. BESTIMMUNG VON KUPFER IN TRINKWASSER DURCH OXIDATION VON KUPFERDITHIOOXAMID),
Gesamthochschule Siegen (Germany, F.R.). Analytische Chemie.
H. Monien, and U. Gerlach.
Fresenius Zeitschrift fuer Analytische Chemie, Vol 306, No 2/3, p 136-143, 1981. 7 Fig, 3 Tab, 15 Ref. English summary.

Descriptors: *Drinking water, *Water analysis, *Copper, Oxidation, Electrodes, *Pollutant identification, Carbon paste electrode.

A procedure for inverse voltammetry of some copper chelates is described which uses a carbon paste electrode and offers some advantages over mercury electrodes, since interferences are less. Dithio-oxamide, 2,2' diquinoline, neocuproine and bathocuproine can be oxidized at the carbon past electrode as well as the corresponding copper chelates. Dithio-oxamide is particularly convenient as a reagent for the determination of copper in the ppb level in the presence of a 100,000-fold excess of other metals. A sample volume between 1 and 10 ml is sufficient for the d.c. inverse voltammetric determination of copper in drinking water, allowing 3 min for pre-electrolysis. The oxidation of the copper dithio-oxamide chelate occurs near +0.25V (reference electrode: Ag/AgCl/KC1 sat.) in a base electrolyte (pH 4.1) containing acetate buffer. (Baker-FRC)
W83-03415

IDENTIFICATION AND QUANTIFICATION OF WATER SOLUBLE COMPONENTS OF OUTBOARD MOTOR EXHAUST AND OF GASOLINE IN A NORTH DAKOTA LAKE,
North Dakota State Univ., Fargo. Dept. of Zoology.
J. D. Brammer, and R. L. Puyear.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224436, Price codes: A03 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State University, Fargo, January 1983. 34 p, 8 Fig, 1 Tab, 34 Ref. OWRT A-062-NDAK(1), 14-34-0001-0136.

Descriptors: *Organic compounds, *Gas chromatography, Water analysis, *North Dakota, *Outboard motor exhaust, *Hydrocarbons, *Pollutant identification, Lakes, Recreation, Monitoring, Lake Metigoshe.

Part I: A 7.0 horsepower (HP) and a 10.0 HP outboard motor were operated at 3,500 + or - 200 revolutions-per-minute (rpm) and 1,7-0 + or - 200 rpm respectively for 30 min in a 160 L tank of tapwater. Exhaust hydrocarbons were concentrated by passage through a C sub 18 reverse phase extraction column, and then eluted with either ethylacetate or acetonitrile. Gas-liquid (GLC) and/or high performance liquid (HPLC) chromatography analyses were used for identification and quantification of nine hydrocarbons. Identities were confirmed for seven of these using GLC/mass spectrometry. Four addtional hydrocarbons were tentatively identified with these procedures. Aromatic compounds composed the majority of the hydrocarbons detected; only a few aliphatics were present and those in trace amounts. Part II: A heavily used recreational lake (Lake Metigoshe, N.D.) was monitored for the presence and/or accumulation of water-soluble hydrocarbons. Surface and bottom samples were taken from five sites between March 1979 and January 1980. Samples were analyzed as described above. No hydrocarbons of petroleum origin were identified. Some hydrocarbons, thought to be chiefly of biological origin, were detected and did increase over the boating season. Five variables (date, water, temperature, site location, sample depth, and wind velocity) were statistically analyzed for correlation with mean total hydrocarbon concentrations. Of these five variables, date and water temperature appeared to be the factors most closely associated with total hydrocarbon concentration.
W83-03428

ON THE ANALYSIS OF TRACE ELEMENTS HARMFUL TO HUMANS IN RIVER SEDIMENTS (ZUR ANALYTIK HUMANGEFAHRLICHER SPURENELEMENTE IN FLUSSSEDIMENT),
Erlangen-Nuernberg Univ. (Germany, F.R.). Inst. fuer Geologie und Mineralogie.
B. R. Reichel, B. Reichel, and K. G. Poll.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 2, p 69-72, February, 1981. 6 Fig, 25 Ref. English abstract.

Descriptors: *Trace metals, *Sediments, *Rivers, *Autoclaves, *Water analysis, *Polarographic analysis, Lead, Zinc, Cadmium, Copper, Teflon, Chemical analysis, Acids, Physical analysis, Decomposition, Vaporphase decomposition, *Pollutant identification.

An apparatus and method for the analysis of trace elements in river sediment is described that eases the problems of separating organic from inorganic components. The method is a variant of acid decomposition using a teflon autoclave with hydrofluoric and nitric acids as reagents and utilizing polarography to determine zinc, cadmium, lead, and copper in the decomposed samples to avoid the necessity of further separation processes. Con-

tamination of the sample with the reagents does not occur with the method, which, with its closed-system vapor phase decomposition apparatus, also almost completely eliminates evaporation loss. The rim of the teflon autoclave is lined with aluminum to increase the stability of the teflon (this also decreases the thickness of the teflon wall), metal plates are placed at the top and bottom of the autoclave, a tightening screw is installed at the bottom, and two cup springs are inserted above the top metal plate. The procedure for decomposition to prepare a sample for the polarographic determination of zinc, cadmium, lead, and copper is as follow: measurement of 50 mg finely ground dried sample into the sample holder, addition of 5 ml HN03 into the acid container decomposition of organic components at 170C (duration = 12 hr), cooling of the autoclave, addition of 3 ml HF 936%) and 4 ml HN03 (fuming), decomposition of silicate and quartz at 110C (dur ation = 12 hr), transfer of the dry sample into a 25-50-ml flask, and dissolution with water. The polarographic method of choice is differential pulse stripping voltammetry at a hanging mercury drop electrode (HMDE), which produces highly accurate results. An attempt is being made to develop a teflon capillary to avoid the constant resiliconization that occurs with the addition of a conduction electrolyte to the HMDE. (Gish-FRC)
W83-03442

HEAVY METALS IN FLOWING WATERS AND RIVER SEDIMENTS OF THE WESTERN HARZ REGION (SCHWERMETALLE IN DEN FLIESSGEWASSERN UND FLUSSSEDIMENTEN DES WEST-HARZES,
Thessaloniki Univ., Salonika (Greece). Pollution Control Lab.
For primary bibliographic entry see Field 5B.
W83-03457

RELATIONSHIPS AMONG THE BACTERIA INDICATORS OF FECAL POLLUTION IN THE WATER OF THE RIVER BRENTA (RELAZIONI TRA GLI INDICATORI DI INQUINAMENTO FECALE NELLE ACQUE DEL FIUME BRENTA)
Padua Univ. (Italy). Ist. di Igiene.
A. Zitelli, O. Salvadori, V. Marin, and B. Duzzin.
Igiene Moderna, Vol 75, No 6, p 719-734, 1981. 4 Fig, 8 Tab, 22 Ref. English summary.

Descriptors: *Bioindicators, *Bacteria, *Coliforms, Rivers, *Feces, Water pollution, Escherichia coli, Streptococcus, Salmonella, Statistical analysis, Water analysis, Regression analysis, Least squares method, Correlation analysis, Brenta river, *Italy, Public health, Water quality.

An analysis is presented of relationships among different indicator bacteria and some chemical and physical parameters of the water of the river Benta. Bacterial indicators of fecal pollution include: TBT total plate count at 20 deg C, TBT total plate count at 37 deg C, total coliforms (TC), fecal coliforms (FC), and fecal streptococci (FS). The FC/FS ratios decreased downriver and were consistently high in low lying areas. Least squares regression analysis was performed on different parameters. These results were consistent with other statistical results, which indicated no correlation between FC and TC, a correlation of one between FC and TBT at 37 deg C, and a correlation of one been FS and TBT at 37 deg C. Correlation coefficients for these relationships were significant at a 99.9% probability level. With the exception of BOD5, no significant correlations were found between single indicator bacteria and other chemical or physical water parameters. While E. coli occurred at a high rate, no salmonellae were isolated. (Small-FRC)
W83-03485

APPLICATION OF KELGRAPH TO ELECTROCHEMICAL DETECTORS FOR FLOW INJECTION ANALYSIS AND HIGH PERFORMANCE LIQUID CHROMATOGRAPHY,
North Dakota State Univ., Fargo. Dept. of Chemistry.
D. E. Weisshaar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-226928, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, North Dakota State University, Fargo, January 1983. 81 p, 12 Fig, 6 Tab. OWRT A-063-NDAK(1), 14-34-0001-9036.

Descriptors: *Chemical analysis, *Water analysis, *Electrochemistry, *Chromatography, Electrodes, Organic compounds, Phenols, Organic waste, Graphite, Kel-F, Electron microscopy detector, *Pollutant identification.

The active area of Kel-F graphite composite (Kelgraf) electrodes determined from short time chronoamperometric data agree well with the weight percent of graphite in the composite and with the percent conducting carbon on the surface determined from x-ray photoelectron spectroscpopy(XPS). Kelgraf electrodes and composite electrodes in general are predicted to exhibit a signal to nosie (S/N) enhancement over continuous electrodes like glassy carbon. The S/N enhancement depends on the active area and the active and inactive site dimensions on the electrode. For Kelgraf these parameters can be tailored to a specific application by control of the percent of graphite in the composite and the particle sizes of the Kel-F and graphite use in fabrication. The performance of Kelgraf as an electrode for electrochemical detection in flowing streams is discussed, including the determination of the optimum electrode composition and the linear dynamic range of the detector. The detector was applied to the determination of phenols in groundwater and coal gasification waste water. Detection limits ranged from 3-15 pg for a variety of phenols. No fouling of the electrode was evident. Evidence based on chronoamperometry, XPS, SEM, cyclic voltammetry and capacitance measurements point to the existence of a partial thin film of Kel-F over portions of the graphite sites. The implications of the presence of such a film are also discussed.
W83-03490

5B. Sources Of Pollution

BIODEGRADATION OF 1,3-DINITROBENZENE,
Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
W. R. Mitchell, and W. H. Dennis, Jr.
Journal of Environmental Science and Health, Part A, Vol 17, No 6, p 837-853, 1982. 4 Fig, 1 Tab, 26 Ref.

Descriptors: Industrial wastes, *Aromatic compounds, *Degradation, Fate of pollutants, Organic compounds, *Dinitrobenzene, *Microbial degradation, *Biodegradation, *Tennessee River, Adaption, Tennessee, Maryland.

1,3-Dinitrobenzene was degraded microbially in water samples taken downstream of the Volunteer Army Ammunition Plant, Chattanooga, Tennessee, but not in water from streams near Frederick, Maryland. Degradation of the 5 microgram per liter solution proceeded after a 10 day lag and was complete by Day 15. Microorganisms from the Tennessee River were able to grow with 1,3-dinitrobenzene as the sole carbon source with a half-life of about 1 day. Enriching the cultures degraded the compound to carbon dioxide with a half-life of 9.7 days. The 1,3 dinitrobenzene-adapted organisms did not grow with the other munitions manufacturing wastes tested: 1,3 dinitrobenzene, 1,4-dinitrobenzene, 3,5-dinitroaniline, 1,3,5-trinitrobenzene, or nitrobenzene. (Cassar-FRC)
W83-03155

INFLUENCE OF LAND UTILIZATION ON HYDROCARBON RUNOFF POLLUTION,
New Jersey Dept. of Environmental Protection, Trenton.
J. Kashner, and J. V. Hunter.
Journal of Environmental Science and Health, Part A, Vol 18, No 1, p 135-144, 1983. 3 Tab, 7 Ref.

Descriptors: *Land use, *Hydrocarbons, *Storm wastewater, Water pollution sources, Fate of pollutants, Sediments, Storm runoff, *New Jersey, Particulate matter, Organic compounds, Aromatic compounds, Aliphatic hydrocarbons, Volatile solids, New Brunswick.

Hydrocarbon pollution from two similar streams with different land uses near New Brunswick, New Jersey, was determined from sediment samples. Mile Run was 38% residential, 19% industrial/commercial, and 43% open. Beaverdam Brook was 82% residential and 18% open. The concentration of aliphatic and aromatic hydrocarbons in Mile Run sediments (total 0.05-0.47%, mean 0.18%) averaged 3-4 times the concentrations of these hydrocarbons in Beaverdam Brook sediments (0.006-0.240%, mean 0.052%). The differing levels of organic matter in the two types of sediments did not account for the differences in concentrations of hydrocarbons. Hydrocarbons in Mile Run sediments were less aliphatic in character than the Beaverdam Brook sediments. (Cassar-FRC)
W83-03156

APPLICATIONS OF A SERRATIA MARCESCENS BACTERIOPHAGE AS A NEW MICROBIAL TRACER OF AQUEOUS ENVIRONMENTS,
Wessex Water Authority, Poole (England). Divisional Microbiology Lab.
D. F. Drury, and D. C. Wheeler.
Journal of Applied Bacteriology, Vol 53, No 2, p 137-142, October, 1982. 3 Fig, 3 Tab, 13 Ref.

Descriptors: *Fate of pollutants, *Bacteriophage, *Tracers, *Flow characteristics, *Bioindicators, Viruses, Microorganisms, Microbiological studies, Pollutant identification, Flow rates, Retention time.

A bacteriophage of Serratia marcescens was evaluated as a tracer of flow in four stages of a sewage treatment works process, as a tracer of dispersion of sewage effluent in the receiving water of a treatment plant and as a tracer of river-water flow rate. The NCIB 10645 phage of S. marcescens compared favorably with lithium chloride in demonstrating flow characteristics and retention times of the aeration lane, secondary sedimentation process, trickling filter, and deep shaft pilot plant of a sewage treatment operation. The phage also exhibited virtually identical distribution in a marine harbor to spores of Bacillus subtilis var. niger 36 to 48 hr after their addition to the final effluent of a sewage works which discharged into an adjacent bay. The bacteriophage was also useful in accurately measuring the transit times of river water between two points under various flow conditions. (Geiger-FRC)
W83-03165

EVALUATING THE RELEASE OF SOLUBLE COMPONENTS FROM SEDIMENT,
Technion - Israel Inst. of Tech., Haifa.
Y. Avnimelech, M. Yamamoto, and R. G. Menzel.
Journal of Environmental Quality, Vol 12, No 1, p 86-91, January/March, 1983. 6 Fig, 3 Tab, 22 Ref.

Descriptors: *Nutrients, *Adsorption, *Sediments, Lakes, Ponds, Eutrophied lakes, Fate of pollutants, Ammonium, Phosphorus, Organic carbon, Nitrogen, Organic matter, Distribution coefficient, *Oklahoma.

Sediments from flood detention reservoirs and farm ponds in Oklahoma were equilibrated with water to study the distribution of soluble components between sediments and the pore or overlying water. Water bodies were of varied eutrophic states. The extraction of soluble components was described as a function of a linear distribution of the soluble components between the solid and liquid phases and through mass balance considerations. The sizes of potentially available nutrient pools and the distribution coefficients were calculated for ammonium, organic N, and organic C. Ammonium, which is bound onto the solid phase as an exchangeable cation, showed very good correlation between experimental and theoretically derived data over the experimental dilution range (up to 1:400 sediment/water ratios). Behavior of

organic C and organic N is more complex. Phosphorus did not follow the model. (Cassar-FRC)
W83-03168

THE ROLE OF DELAWARE RIVER FRESHWATER TIDAL WETLANDS IN THE RETENTION OF NUTRIENTS AND HEAVY METALS,
Rider Coll., Lawrenceville, NJ. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W83-03169

THE EXTENT AND NATURE OF RAINFALL-SOIL INTERACTION IN THE RELEASE OF SOLUBLE CHEMICALS TO RUNOFF,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
L. R. Ahuja, and O. R. Lehman.
Journal of Environmental Quality, Vol 12, No 1, p 34-40, January/March, 1983. 9 Fig, 10 Ref.

Descriptors: *Infiltration, *Solute transport, *Agricultural runoff, Runoff, Nonpoint pollution sources, Permeability, Mixing, Water pollution sources, Soil properties, Soil surfaces, Soil solution, Fate of pollutants.

Soluble soil chemicals were readily released into runoff from soils with a surface layer more permeable than the underlying layers. This was determined from experiments in which simulated rainfall was applied to boxes of soil (fine sandy loam, loam, and clay) prewetted with a 4000 ppm bromide solution. The boxes were constructed to allow three degrees of infiltration during rainfall: free, none, and reduced. In all soils Br levels in runoff were 1-2 orders of magnitude higher from the boxes with no infiltration than from the boxes with free infiltration. The reduced-infiltration boxes had intermediate Br levels in the runoff. This showed that the mixing zone concept currently used in models for the release of chemicals in runoff from land surfaces is not totally valid. With a 1 hour rainfall (6.8 cm of rain) Br was lost to runoff from as deep as 2 cm in the soil in the no-infiltration boxes. The amount released decreased with depth. The mechanism for transfer of a chemical from below a thin soil surface layer is probably a pumping action of, or turbulence generated by, the raindrops' impact. The mixing zone concept was modified by addding an exponential decrease in the degree of mixing with depth and a piston displacement of soil solution by infiltration. Results suggest that solute transport is increased in clay pan soils, wet areas, and where tillage practices have greatly increased permeability of the surface soil. (Cassar-FRC)
W83-03170

HORSES IN SUBURBIA,
Fairfield County Conservation District, Monroe, CT.
For primary bibliographic entry see Field 5G.
W83-03176

THE POTENTIAL FOR ACID PRECIPITATION DAMAGE TO LAKES OF THE SIERRA NEVADA, CALIFORNIA,
California Univ., Berkeley.
J. Harte, J. Holdren, and K. Tonnesson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-214825, Price codes: A04 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, University of California, Davis, April 1983. 13 p, 3 Fig, 1 Tab, 10 Ref, 3 Append. OWRT-A-081-CAL(1).

Descriptors: *Acid rain, *Chemistry of precipitation, *Lakes, *California, *Mountain lakes, Environmental effects, Alkalinity, Hydrogen ion concentration, Sierra Nevada region.

Acid precipitation in the western United States is now being measured and monitoring networks are being set up to determine the nature and extent of its occurence. In California two recent studies have documented instances of acidic deposition. It would appear that in the State the nitrate component often outweighs the sulfate contribution in rainfall. One of the areas of California potentially sensitive to acidic deposition is the Sierra Nevada, located along the eastern boundary. A report on sensitive areas in North America identifies the Sierra as a region characterized by poorly buffered soils and granite based lakes. The subalpine and alpine lakes in this region share many of the characteristics of lakes adversely affected by acid deposition in other parts of the U.S. and the world. For this investigation selected subalpine lakes of the western slope of the Sierra were chosen for study, to establish baseline water quality which would allow for the identification of chemical and biological changes due to acidic doposition. It was then attempted to simulate the ecosystem stress of increased acidic deposition, particularly in the form of snowmelt, on these systems by performing microcosm experiments in the laboratory. These experiments were particularly concerned with recording changes in concentrations of micronutrients which might be leached from lake sediments with increasing acidification. This phenomenon is particularly important to study in the light of finds on the importance of aluminum leaching in the Northeast which has led to toxic effects on biota in Adirondack lakes. (Snyder-California)
W83-03182

DISTRIBUTED SOURCE MODEL FOR PESTICIDES IN THE IOWA RIVER,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
J. L. Schnoor.
Iowa State Water Resources Research Institute, Publication No 107, Iowa State University, Ames, January 1983. 39 p, 8 Fig, 2 Tab, 1 Append. OWRT A-070-IA(1), 14-34-0001-8017.

Descriptors: *Pesticides, *Dieldrin, *Model studies, *Nonpoint pollution sources, Water quality management, Rivers, Sediment-water interfaces, Iowa River, *Iowa, *Path of pollutants, Simulation analysis, Sediment transport, Pesticide transport.

A time-variable water quality model of pesticide concentration in streams and rivers was developed. The pesticide concentrations of dieldrin in the Iowa River was used to calibrate the model. However, due to the lack of field data before and after implementation of best management practices (BMPs), a quantitative evaluation of the improvements due to BMPs was not possible. The model consisted of a series of complete-mixed compartments to simulate the dissolved hydraulic transport of the pesticides. A sediment bed compartment was included to simulate the interactions of the pesticide between the sediment and dissolved phases. The model gave reasonable simulation results but complete verification was not possible because of the lack of field data.
W83-03186

MODIFICATION OF POLLUTANT HYDROLYSIS KINETICS IN THE PRESENCE OF HUMIC SUBSTANCES,
Environmental Research Lab., Athens, GA.
E. M. Perdue, and N. L. Wolfe.
Environmental Science and Technology, Vol 16, No 12, p 847-852, December, 1982. 8 Fig, 5 Tab, 16 Ref.

Descriptors: *Humic acids, *Hydrolysis, *Kinetics, *Fate of pollutants, Water pollution sources, Organic compounds.

Effects of humic substances on the kinetics of hydrolysis of the 1-octyl ester of (2,4-dichlorophenoxy)acetic acid (2,4-DOE) were investigated. In distilled water at pH 4 and above, hydrolysis is governed by second-order alkaline hydrolysis kinetics. The hydrolysis kinetics are complicated by sorption of the ester to the glass container walls. System specific sorption-desorption rate constants for the ester are relatively small. Competitive equilibrium studies between glass walls, water, and dissolved humic substances give partition coefficients for the humic material of 10,000 to 100,000. Similarly, hydrolysis studies in the presence of various humic substances give calculated partition coefficients in the range 10,000 to 100,000. General acid-base catalysis by dissolved humic substances, if operative at all, is masked by the sorption phenomenon. The overall effect of the humic material is an apparent decrease of the alkaline hydrolysis rate constant by a factor equal to the fraction of the ester associated with the humic substances. (Baker-FRC)
W83-03193

CONTROL OF TRIHALOMETHANES IN BARCELONA'S WATER SUPPLY (CONTROLE DES TRIHALOMETHANES DANS LES EAUX D'APPROVISIONNEMENT DE BARCELONE),
Instituto de Quimica Bio-Organica, Barcelona (Spain).
J. Rivera, and F. Ventura.
Aqua, No 5, p 0469-0474, 1982. 4 Fig, 2 Tab, 8 Ref.

Descriptors: Water supply, Water quality, *Raw water, *Potable water, Water pollution, Rivers, Median tolerance limit, Halogens, *Bromides, Industrial wastes, *Mine drainage, Mineral industry, Drinking water, Chlorination, Llobregat River, *Spain, *Water pollution sources, *Trihalomethanes, Disinfection, Barcelona, Salt mines.

The method and results of a water quality study are described. Raw water taken from the Llobregat river, Spain, as well as different points within the water treatment plant at Sant Joan Despi in 1979, 1980, and 1981 was analyzed for trihalomethane contamination. This water is supplied to the city of Barcelona and surrounding areas. Results show higher levels for bromemethanes than those commonly cited in the literature. The total trihalomethane concentration is often higher than 100 parts per billion, which exceeds the upper limit for drinking water established by the United States Environmental Protection Agency. These results are in agreement with the presence of significant amount of organic matter in raw water containing precursors of trihalomethanes found at the chlorination process. The presence of bromomethanes is believed to be linked to bromide in the raw water of salt mines located upstream. (Titus-FRC)
W83-03210

TUFA PRECIPITATION AND ITS EFFECT ON DRAINAGE OF INTERSTATE HIGHWAYS IN NORTHEASTERN OHIO,
Kent State Univ., OH. Dept. of Geology.
R. M. Feldmann, D. J. Biros, and D. L. Middleton.
Bulletin of the Association of Engineering Geologists, Vol 19, No 4, p 347-370, November, 1982. 18 Fig, 24 Ref.

Descriptors: *Tufa, *Drainage, *Highways, *Ohio, Geochemistry, Hydrogeology, Calcium carbonate, Drainage systems, Roads, Slag, Construction, Drainage engineering.

Calcareous tufa has been observed occluding drain outlets and catch basins as well as covering slopes at 124 localities in Cuyahoga, Portage, Summit, and Medina counties in northeastern Ohio. Blockage of the drains by this material is impeding drainage of the subbase, which may have harmful consequences such as slope failure on saturated embankments, freeze-thaw damage, pumpout of bedding materials under loading of flexible pavement areas, and deterioration in mechanical properties of pavement. Regional geological studies, hydrogeological studies, and geochemical analyses have been employed to identify the source and mode of origin of this material. No correlation was found between tufa formation and regional geologic and hydrogeologic conditions. Geochemical analysis of water collected from subbase drain outlets and of an array of construction material leads to the conclusion that slag, when used as a subbase material, is sufficiently soluble to affect the pH of drainage water and to provide the calcium deposited as tufa. Solution of calcium hydroxide in slag in the subbase elevates the pH of drainage water above 10.3 and produces an environment in which calcium carbonate can be precipitated. The problem of tufa deposition will continue in northeast Ohio as long as slag is used as a subbase material. However, careful maintenance of the highway surface to reduce the amount of water entering the drainage system through edge joints and cracks in the pavement will significantly

reduce the magnitude of the problem. (Baker-FRC)
W83-03213

FISH FARM EFFLUENTS--CAUSE FOR CONCERN,
J. F. Solbe.
Water, No 43, p 22-25, March, 1982. 1 Fig, 3 Tab.

Descriptors: *Fish farming, *Water quality, Rivers, Water pollution sources, Suspended solids, Dissolved oxygen, Biochemical oxygen demand, Phosphorus, Water pollution effects, Nitrogen, *United Kingdom.

Increasing fish farming in fresh water in the United Kingdom has led to concerns regarding the effects of these farms on water quality. Fish farms, which are often located upstream of potable water supply intakes, do not treat water they use prior to discharge to the receiving waters. In many cases, they use the whole flow of the river, since the production of a ton of freshwater fish requires the utilization of about 250 mission liters of water. A survey was conducted to determine the types of fish farms operating in 1980; their rates of production; their sources of water; the treatment, quality, and fate of their effluents; the usage of chemicals; and the nature of the water to which their effluents were discharged. Although most fish farms were small, 10 percent of the farms accounted for over half of the total production of the farms surveyed. In addition, in some instances series of several farms were located on a given stretch of river. Although the majority of fish farms use some chemicals, often antibiotics or antibacterial agents, little is known about the effects of these chemicals on wild fish populations, other farmed fish, or humans. Water passing through fish farms experienced a decrease in dissolved oxygen concentration and increases in biochemical oxygen demand, suspended solids, phosphorus, ammonia, nitrite, and nitrate. The increases in nitrogen and phosphorus can pose problems for oligotrophic and other sensitive waters. Suspended solids are the most obvious cause of complaint, with the average fish farm discharging the same amount of solids as an efficient sewage works serving 21,000 people. Although only 15 percent of the fish farms have been involved in pollution incidents, further development of the indsutry could lead to problems on reaches of rivers where one or more fish farms already exist. (Carroll-FRC)
W83-03237

FREE IONIC NICKEL ACCUMULATION AND LOCALIZATION IN THE FRESHWATER ZOOPLANKTER, DAPHNIA MAGNA,
Toronto Univ. (Ontario). Dept. of Botany.
T. M. Hall.
Limnology and Oceanography, Vol 24, No 4, p 718-728, July, 1982. 6 Fig, 3 Tab, 24 Ref.

Descriptors: *Fate of pollutants, *Nickel, *Daphnia, *Kinetics, *Adsorption, Accumulation, Excretion, Model studies, Heavy metals, Metals, Crustaceans, Absorption, Aquatic insects, Radioactive tracers, Zooplankton.

The processes which lead to the accumulation of free radioactive ionic nickel by Daphnia magna from solution were examined and formulated into a model which describes accumulation at different concentrations. The kinetics of nickel uptake and distribution by various body components were included to substantiate accumulation data and further the understanding of nickel turnover by Daphnia. Adsorption was found to play only a small role in the accumulation of nickel. Adsorption by exuviae alone was complete in 1 hr. Excretion experiments with intact daphnids demonstrated the presence and kinetics of a more rapidly exchanging pool of more losely bound cation than absorbed Ni. The accumulation rate eventually approached zero, signifying an equilibrium between the uptake and loss of nickel. The appearance and distribution of nickel within the body fluid, carapace, gut, filtering device, and eggs supported findings of other researchers on nickel accumulation and excretion in daphnids and other aquatic crustaceans and added to the understanding of nickel assimulation in the aquatic biosphere. (Geiger-FRC)
W83-03256

SELENIUM IN REDUCING WATERS,
California Univ., Santa Cruz. Center for Coastal Marine Studies.
G. A. Cutter.
Science, Vol 217, No 4562, p 829-831, August 27, 1982. 2 Fig, 14 Ref.

Descriptors: *Selenium, *Anaerobic conditions, *Speciation, Fate of pollutants, Fjords, Oxidation-reduction potential, Zooplankton, Organic compounds, Deep water, Chemical reactions, Saanich Inlet, *British Columbia.

Selenium species were investigated in Saanich Inlet, a fjord on the coast of Vancouver Island, in May 1981. Total water depth was 196 m. The interface between H2S and oxygen was at 175 m; the suboxic zone, 110-170 m; and the oxic zone, 110 m to the surface. Total dissolved Se increased in concentration with depth from about 0.65 nM per kg on the surface to about 1.40 nM per kg at 120 m and decreased to 1.00-1.25 in the deeper anoxic water. Selenite increased from zero on the surface to a maximum of 0.30 nM per kg at 80 m and decreased from about 0.75 nM per kg at the surface to detection limit values (0.01 nM per kg) at 180 m. Hydrogen selenide concentrations were near the detection limit in the anoxic zone. Organic selenide, not detected at the surface, increased gradually to 1.25 nM per kg at the fjord bottom. Both selenate and selenite were present in the oxic waters, although selenate is the only thermodynamically predicted form. The very low levels of selenate and selenite in the anoxic waters indicated a removal mechanism. Although hydrogen selenide is the thermodynamically predicted form in anoxic waters, it was virtually absent, and the dominant species was organic selenide. This may be a result of incorporation of Se into biogenic particulates, which degrade and dissolve in the bottom waters and/or undergo oxidation-reduction reactions. Data suggest that some Se in biogenic matter undergoes a multistep regeneration. The organic selenide state may be the final regeneration step under anoxic conditions, whereas selenite and selenate may be the final regeneration step in oxic water. (Cassar-FRC
W83-03266

STUDY OF THE CHANGES IN RIVER WATER QUALITY (ETUDE DE L'EVOLUTION DE LA QUALITE DES EAUX DE RIVIERE),
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
A. Guilbot, B. Picot-Reboul, M. Bouchaud, and M. Roux.
Water Research, Vol 16, No 7, p 1173-1187, July, 1982. 9 Fig, 7 Ref.

Descriptors: *Rivers, *Water pollution effects, *Water quality, *Statistical analysis, *Graphical analysis, Mathematical studies, Water pollution control, Water analysis, Water pollution sources, Catchment areas, River basins, Water quality management, *France, L'Adour, La Dordogne.

A methodology was developed to determine river water quality and to assess the effectiveness of control measures. The method was tested in two catchment areas in France: L'Adour (15,000 sq km) and La Dordogne (24,000 sq km). Before implementation of the method, it was necessary to collect data on the identification and quantity of pollution sources as well as annual statistics for sampling stations. Statistical analysis was carried out on parameters available for 1971 through 1976. Principal components were analyzed, and all data were analyzed using STATIS. Research was carried outon the causal relationship between water quality and the pollution sources. A simple graphical method is proposed to explain the effect of a strongly preponderant pollutant. A method using BOD was developed for general cases where there are several pollutants. This method compares values measured in the river with estimates of inflows and measurements made in upstream basins. Local and general tendencies resulting from intervention by the Agence Financiere de Bassin can be determined. It will be necessary to extend the statistical method to parameters other than BOD. (Small-FRC)
W83-03267

IDENTIFICATION AND ASSESSMENT OF EFFLUENT RESIDUALS IN TREATED LEACHATE FROM LANDFILL DISPOSAL SITES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5E.
W83-03272

THE MOVEMENT OF NITRATES, PHOSPHATES, AND FECAL COLIFORM BACTERIA FROM DISPOSAL SYSTEMS INSTALLED IN SELECTED CONNECTICUT SOILS,
Connecticut Univ., Storrs. Inst. of Water Resources.
H. D. Luce, and T. G. Welling.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219808. Completion Report, June 1983. 107 p, 63 Fig, 10 Tab, 39 Ref. OWRT A-088-CONN(1), 14-34-000-0107.

Descriptors: *Septic tanks, Septic wastewater, Leaching, Groundwater pollution, Nitrogren, *Nitrates, Nitrogen removal, Nitrification, Nutrient removal, Phosphorus, Ammonium, Denitrification, Chlorides, *Coliforms, Pathogens, Watersheds, Land use, *Soil disposal fields, Soil-type, Soil chemistry, Soil filters, Geohydrology, Glaciohydrology, Glacial soils, Connecticut, *Phosphates.

Groundwater monitoring of five septic tank leaching systems was accomplished. Site 1 consisted of a single system installed in fill over a sandy soil, located upgrade of a wetlands. Site 2 consisted of a 10.1 ha residential watershed in which four systems were studied in detail. This watershed contained a complete topo-drainage sequence of soils underlain by compact till. Wells were utilized to sample groundwater on a monthly basis. In situ measurements and laboratory analyses of various parameters revealed that the soils studied were effective in removing phosphorus, nitrogen, total coliform bacteria and fecal coliform bacteria. The processes of nitrification and denitrification were observed. The groundwater and surface water quality of this residential watershed was compared with two other watersheds that were similar in soils and topography. One of these two watersheds was in forestry, the other in forage crops. The concentraion of P was similar in all watersheds. The concentration of soluble N was less than 1 mg/1 in the stream waters exiting the forested watershed and was dominantly in the NH sub 4-N form. The concentration of soluble nitrogen exiting the other two watersheds was about 3 mg/1, being dominantly in the NO sub 3-N form in the farmed watershed and being equally divided between NH sub 4-N and NO sub 3-N in the residential watershed. There is some evidence that the amount of soluble N exiting the latter two watersheds was greatly affected by denitrification.
W83-03276

POST-MINING NEUTRALIZATION OF ACIDIC SURFACE MINE LAKES,
Southern Illinois Univ. at Edwardsville. Dept. of Biological Sciences.
R. B. Brugam, M. A. Carlson, S. Chakraverty, and M. Lusk.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219923, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Center Research Report No 178, Univ. of Illinois, Urbana, April 1983. 103 p, 35 Fig, 9 Tab, 57 Ref. OWRT B-138-ILL(3), 14-34-0001-1220.

Descriptors: *Acid mine drainage, *Strip mine lakes, *Lake sediments, Paleolimnology, *Diatoms, *Lead radioisotopes, *Sedimentation rates, Chemical composition, *Neutralization, Mine lakes, Illinois, Indiana, Missouri.

Twenty core samples and 54 surface sediment samples were taken from surface mine lakes in Missou-

ri, Illinois, and Indiana to determine the rates of neutralization of acid mine lakes. Sediment samples were analyzed for diatom microfossils, selected chemical elements, and the radionuclide, lead-210. The surface samples showed that there were strong differences in diatom microfossils between acidic and neutral lakes but there was no strong difference in sediment chemical composition between acidic and neutral lakes. Of 20 lakes from which cores were examined, 9 showed diatom evidence of neutralization and one of acidification over time. Cores from 5 of these were dated using lead-210 analysis. Diatom microfossils showed that neutralization took from less than 3 years to 30 years to occur. Comparisons between lake sediment and water column chemistry indicated that neither sulfide deposition nor H sub 2 S outgasing is likely to play a major role in the neutralization process. Chemical analyses of lake sediment showed that the sediment is a sink for heavy metals. These metals are held as sulfides. There is also a considerable fraction of metal ions strongly bound to clays. This research demonstrates that acid lake neutralization is common, that it occurs over moderate time spans and that the rate is controlled by rates of acid supply from the watershed.
W83-03278

INFLUENCE OF AGRICULTURAL DRAINAGE ON WATER QUALITY,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
W. F. Ritter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220327. Water Resources Center Completion Report, Univ. of Delaware, Newark, April 1983. 32 p, 2 Fig, 18 Tab, 20 Ref. OWRT A-056-DEL(1), 14-34-0001-2108.

Descriptors: Water quality, *Surface drainage, *Nitrogen, *Phosphorus, *Agricultural watersheds, Agricultural hydrology, *Delaware, Land use, Marshyhop Creek watershed, Pepper Creek watershed, Upper Choptank River watershed.

Three agricultural watersheds located in western Kent Co. in the Choptank River basin were monitored from March to September, 1982. Drainage construction was in progress on one of the watersheds, another watershed had no drainage construction, and the third watershed had drainage constructed approximately ten years of age. Storm runoff and baseflow samples were analyzed for ammonia, nitrate nitrogen, organic nitrogen, ortho phosphorus, total phosphorus, turbidity, suspended solids, and dissolved solids. Ongoing drainage construction had more impact on baseflow chemical parameters concentrations than storm runoff concentrations. On the watershed where drainage construction was in progress, nitrate nitrogen, total phosphorus, turbidity, suspended solids, and dissolved solids concentrations were increased. Suspended solids concentrations were higher on the watershed where no drainage has been constructed for some storms because of sediment flotation.
W83-03289

EFFECT OF INCORPORATION OF FALL-APPLIED FERTILIZER ON RUNOFF LOSSES OF NUTRIENTS AND SOIL FROM SOYBEAN GROUND,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W83-03298

PHOSPHATE RELEASE IN LABORATORY SOIL COLUMNS,
Rhode Island Univ., Kingston. Dept. of Plant and Soil Science.
T. J. Bicky, and W. R. Wright.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220384, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center Technical Report No 9, Rhode Island Univ., Kingston, September 1982. 6 p, 2 Tab, 2 Ref. OWRT A-075 RI(1), 14-34-0001-1142.

Descriptors: *Phosphorus, Cesspools, Soil chemistry, Pollutant identification, Soil columns,.

A soil column study was initiated to determine the magnitude of phosphorus release from phosphorus enriched soil treated with various rejuvenation products. Columns filled with soil collected at the base of seepage pits (cesspools) were treated with 100 ml solutions of 50% H 2S04, 16% H202, 1% Drainz, 1% enzyme and distilled water. Total phosphorus was determined on column extracts after contact times of 24 and 168 hours. The results indicate that the H2S04 treatment extracted the greatest amount of phosphorus from the soil followed by peroxide H202, Drainz and enzyme treatments. Increasing contact time increased amounts of total phosphorus in the H2S04 and enzyme treatments. Problems associated with the fate of release phosphorus from these systems needs to investigated further.
W83-03301

THE FATE OF ANTIFOULANT ORGANOTIN COMPOUNDS IN WATER SYSTEMS,
District of Columbia Univ., Washington. Coll. of Physical Science, Engineering, and Technology.
I. J. Posey, and G. Eng.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220590, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Report No 46, Univ. of the District of Columbia, Washington, D. C., May 1983. 22 p, 9 Fig, 2 Tab, 21 Ref. OWRT A-020-DC(1), 14-34-0001-2109.

Descriptors: *Antifoulants, *Water pollution sources, *Organotin compounds, Fate of pollutants, *Infrared analysis, Leaching, Chromatography, *Pollutant identification, Residues.

Several antifoulant organotin compounds, Ph sub 3 SnOH, Ph sub 3 SnCl and Ph sub 3 SnOCOCH sub 3, were leached by suspending them in distilled water and shaking mechanically for periods up to two weeks at room temperature. Benzene or chloroform extracts of these aqueous solutions were evaporated to dryness and the infrared spectra of the resulting residues were obtained. Except for the residue resulting from the extract of aqueous Ph sub 3 SnOCOCH sub 3, the infrared spectrum of each residue was identical to that of the starting organotin compound. The infrared spectrum of the residue obtained from the chloroform extract of aqueous Ph sub 3 SnOCOCH sub 3 which had been shaken for seven days showed the presence of Ph sub 3 SnOH as confirmed by the presence of a small doublet around 910 and 897 cm -super 1. The pH measurements on the aqueous solutions of these organotin compounds showed a decrease in pH with time. These results are perhaps indicative of an ionization of the organotin compounds in water. TLC experiments using various developing solvents did not allow for the resolution of mixtures of Ph sub 3 SnCl, Ph sub 3 SnCl and Ph sub 3 SnOCOCH sub 3; therefore, TLC was not feasible for use in this study.
W83-03315

AN EVALUATION OF SEDIMENTS IN THE MIDDLE RIO GRANDE, ELEPHANT BUTTE RESERVOIR, AND CABALLO RESERVOIR AS POTENTIAL SOURCES FOR TOXIC METERIALS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Chemistry.
C. J. Popp, D. J. Brandvold, T. R. Lynch, and L. A. Brandvold.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-221754, Price codes: A06 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute Report No 161, Las Cruces, March 1983. 97 p, 11 Fig, 39 Tab, 61 Ref, 3 Append. OWRT A-065-NMEX(1), 14-34-0001-1133.

Descriptors: *Heavy metals, *Organic pesticides, Water quality, Fish tissues, Chlorinated organic pesticides, Pesticides, Radionuclides, Reservoir sediments, *Suspended sediments, Middle Rio Grande River, *New Mexico, *Path of pollutants, Elephant Butte Reservoir, Caballo Reservoir.

The distribution of a large number of priority pollutant trace metal and organic species in water and sediments in surface waters in the Middle Rio Grande region of New Mexico has been surveyed. In addition to sediments and water, limnological data was collected on the reservoirs, radionuclide and particle size analysis was performed on the sediments and a limited number of fish were surveyed for trace metals and organics. The sediments carry elevated levels of the metals Hg, Cd, As, Se, and U and fish may be biomagnifying Hg, Pb, and V through the food chain. Mercury levels in fish are high enough to warrant concern from a health standpoint. Detectable levels of 18 different chlorinated organic pesticides were found in samples of water and bottom sediments. These pesticides were found predominantly in association with suspended particulates or with fine particles in the bottom sediments. Pesticides were detected more frequently in the Fall than in the Spring. Because of heavy sediment inputs contaminated by adsorbed pesticides, the calcultated annual input to Elephant Butte Reservoir lies between 900-11,000 kg for each of the seven most frequently detected pesticides.
W83-03322

CHEMICAL EFFECTS OF SELECTED TRACE-METALS FROM SANITARY LANDFILL LEACHATES ON GROUNDWATER QUALITY,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 5E.
W83-03340

EFFECTS OF SURFACE APPLICATION OF DAIRY MANURE ON THE INFILTRATION RATE AND QUALITY OF SURFACE RUNOFF,
Kentucky Water Resources Research Inst., Lexington.
J. L. Tarab, I. J. Ross, J. D. Bottom, and B. J. Barfield.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222422, Price codes: A05 in paper copy, A01 in microfiche. Research Report No 138, June 1983. 86 p, 10 Fig, 18 Tab, 47 Ref, 1 Append. OWRT A-081-KY(1), 14-34-0001-0119, 14-34-0001-0119

Descriptors: *Agricultural runoff, *Animal wastes, *Manure, *Non-point pollution sources, Pollution load, Soil treatment, Kentucky, Dairy manure, Loam, *Infiltration rates, Nitrogen.

Dairy manure was surface spread on 12 ft x 12 ft plots on an established fescue pasture in the summer and fall of 1981 and 1982. The soil was a Murray silt loam. A simulated rainfall was applied to plots to test the effects of nitrogen rate (75, 150, and 300 No N/acre) time delay between manure application and the simulated rainfall events (o, 3, 6, 24, 48, 96 hours and 120 hour test repeated on 0 hr plot with 300 No N/acre), and type manure (semi-solid - 1981 and liquid - 1982) on the concentrations of pollutants in the surface runoff. The pollutants measured were COD, TSS, FSS, VSS, TS, FS, VS, NO sub 3, NH sub 4, N, P, and K. The simulated rainfall rates were 3.42 in/hr for 1981 and 4.02 for 1982. The average field infiltration rate for the non-manured test plots were 3.40 in/hr in 1981 and 4.42 in/hr in 1982. The infiltration rates of the manured plots were reduced by 5.8 to 15% for semi-solid manure and 23 to 31% for liquid manure for zero hour time delay plots. The infiltration rates increased to within 92% of the control plots after 120 hour time delay. The pollutant yields increased with nitrogen loading rate except for FSS yield which remained below the control plot yields. The N0 sub 3 yields was below the control plot except for 300 No N/acre plots. The reduction in pollutant yields with increased time delay was found to average 46 and 76% for the 24 and 48 hour time delays for semi-solid manure and 75 and 94% for liquid manure. The yields for TSS, FSS and VSS for liquid manure did not exceed the control after 48 hours.
W83-03344

THE ROLE OF FULVIC SUBSTANCES ON TRACE METAL PARTITIONING IN NATURAL AQUATIC SEDIMENTS,

Massachusetts Univ., Amherst. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W83-03348

WATER QUALITY OF AIRPORT STORM RUNOFF,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
E. Christakos-Comack, and G. L. Dugan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224170, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 144, July 1982. 30 p, 5 Fig, 7 Tab, 22 Ref. OWRT A-086-HI(1), 14-34-0001-1113.

Descriptors: *Storm runoff, *Water supply, *Water quality standards, Water sampling, Pollutant identification, Heavy metals, *Hawaii, *Honolulu International Airport, *Nonpoint pollution sources.

The quality of natural and induced storm runoff was ascertained from the 11.33 x 10 super 6 m super 2 (2800 acre) Honolulu International Airport (daily average air traffic volume of about 1000 planes and a mean annual rainfall of approximately 508 mm (20 in.) by incorporating two monitoring schemes, the wet season and the dry season. The wet-season monitoring involved collecting storm runoff samples during and following rainfall events at established airport sites on paved surfaces. The dry-season monitoring scheme consisted of enclosing a 1.0-m super 2 (10.8-ft super 2) area, applying deionized water, and then collecting the wash water, leached chemicals, and sediments by a heavy-duty vacuum cleaner. Phenol, mercury, and turbidity exceeded the primary drinking water regulations, while pH, manganese, and total dissolved solids at times exceeded secondary drinking water regulations. Grease and oil concentrations showed a definite decrease from the Terminal Building (service and fueling area) to the outer drainage sites. High technology treatment, costing nearly four times the present cost of municipal water, would be required to meet potable water requirements; however, for subpotable use, an equalization basin could be constructed for one-half the cost of municipal water. The 1985 projected water demand volume could be met by recovered storm runoff.
W83-03353

HYDROLOGY OF AREA 14, EASTERN COAL PROVINCE, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W83-03355

CHEMICAL-QUALITY RECONNAISSANCE OF THE WATER AND SURFICIAL BED MATERIAL IN THE DELAWARE RIVER ESTUARY AND ADJACENT NEW JERSEY TRIBUTARIES, 1980-81,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2L.
W83-03363

PRODUCTION AND DECOMPOSITION OF FOREST LITTER FALL ON THE APALACHICOLA RIVER FLOOD PLAIN, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. F. Elder, and D. J. Cairns.
Available from Br. of Distr., USGS, 604 S. Pickett St., Alexandria, VA 22304, Price $5.50. Geological Survey Water-Supply Paper 2196-B, 1982. 42 p, 23 Fig, 10 Tab, 50 Ref.

Descriptors: *Decomposition, *Trees, *Leaves, *Organic matter, Flood plains, Wetbanks, Forest, Litter, Vegetation, Productivity, Cycling nutrients, Detritus, *Florida, Apalachicola River.

Measurements of litter fall (leaves and other particulate organic material) and leaf decomposition were made on the Apalachicola River flood plain in 1979-80. Litter fall was collected monthly in five different forest types in swamp and levee areas. Leaves from 42 species of trees and other plants accounted for 58% of total litter fall. The remaining 42% was nonleaf material. Average litter fall was 800 grams per square meter per year in the flood plain. Tupelo (Nyssa), baldcypress (Taxodium), and ash (Fraxinus), all swamp-adapted trees, produce over 50% of the leaf fall. Common levee species such as sweetgum (Liquidambar styraciflua) and diamond-leaf oak (Quercus laurifolia) are also major contributors to total flood-plain litter fall. Annual flooding of the river provides an important mechanism for mobilization of the litterfall products. Leaf decomposition rates were greatly reduced in dry environments. Carbon loss was nearly linear over a 6-month period, but nitrogen and phosphorus loss was exponential and nearly complete within 1 month. (USGS)
W83-03364

HYDROLOGIC CONDITIONS AT THE IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO--EMPHASIS: 1974-1978,
Geological Survey, Idaho Falls, ID. Water Resources Div.
J. T. Barraclough, B. D. Lewis, and R. G. Jensen.
Available from Br. of Distr., USGS, 604 Pickett St., Alexandria, VA 22304, Price $4.75. Geological Survey Water-Supply Paper 2191, 1982. 52 p, 46 Fig, 4 Tab, 35 Ref.

Descriptors: *Water pollution sources, *Chemical wastes, *Radioactive wastes, *Water quality, Radioactive waste disposal, Groundwater, Aquifers, Observation wells, Groundwater recharge, Water level fluctuations, Path of pollutants, Infiltrations, Geohydrology, *Idaho, Idaho National Engineering Laboratory, Snake River Plain.

Aqueous chemical and radioactive wastes have been discharged to shallow ponds and to shallow or deep wells on the Idaho National Engineering Laboratory (INEL) since 1952 and has affected the quality of the groundwater in the underlying Snake River Plain aquifer. Ongoing studies conducted from 1974 through 1978 have shown the perpetuation of a perched ground-water zone in the basalt underlying the waste disposal ponds at the INEL's Test Reactor Area and of several waste plumes in the regional aquifer created by deep well disposal at the Idaho Chemical Processing Plant (ICPP). The perched zone contains tritium, chromium-51, cobalt-60, strontium-90, and several nonradioactive chemicals. Tritium has formed the largest waste plume south of the ICPP, and accounts for 95% of the total radioactivity disposed of through the ICPP disposal well. Waste plumes with similar configurations and flowpaths contain sodium chloride, and nitrate. Strontium-90, iodine-129, and cesium-137 are also discharged through the well but they are sorbed from solution as they move through the aquifer or are discharged in very small quantities. Strontium-90 and iodine-129 have formed small waste plumes and cesium-137 is not detectable in groundwater samples. Radionuclide plume size and concentrations therein are controlled by aquifer flow conditions, the quantity discharged, radioactive decay, sorption, dilution by dispersion, and perhaps other chemical reactions. Chemical wastes are subject to the same processes except for radioactive decay. (USGS)
W83-03365

ORGANICS TRANSPORTED THROUGH SELECTED GEOLOGIC MEDIA: ASSESSMENT OF ORGANICS TRANSPORTED AWAY FROM INDUSTRIAL WASTE DISPOSAL SITES,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 5A.
W83-03375

FECAL COLIFORM RELEASE STUDIES AND DEVELOPMENT OF A PRELIMINARY NONPOINT SOURCE TRANSPORT MODEL FOR INDICATOR BACTERIA,
Utah State Univ., Logan.
E. P. Springer, G. F. Gifford, M. P. Windham, R. Thelin, and M. Kress.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224253, Price codes: A06 in paper copy, A01 in microfiche. Utah Water Research Laboratory Hydraulics and Hydrology Series UWRL/H-83/02, Utah State Univ., Logan, April 1983. 108 p, 54 Fig, 34 Tab, 71 Ref. OWRT A-048-UTAH(1), 14-34-0001-0147.

Descriptors: Grazing, Cattle, Feces, *Bacteria, *Coliforms, *Animal wastes, Kinematic waves, Overland flow, Stochastic processes, *Non-point pollution sources, Model studies, Bioindicators, Path of pollutants, Rainfall intensity, Land use.

Grazing is a primary land use and one that creates significant volumes of animal waste and can pose a significant threat to water quality. This study combined laboratory work to derive a relationship quantifying the rate of release of coliforms from cattle fecal deposits and a general transport model describing indicator bacteria movement overland into channels. Experimental determination of a release function was based on rainfall simulated on standard cowpies and measured fecal coliform counts in the runoff. Peak coliform release rates were found to decline with age. Rainfall intensity had little effect on coliform release from new deposits but a deposit age of over 20 days, low intensity rains gave significantly higher counts. For modeling coliform movement, overland flow as modeled by kinematic routing, and bacterial transport was modeled with a random ordinary differential equation. Overall, the model did not do very well in predicting bacteria movement quantitatively. It did show that bacteria are moved long distances on smooth surfaces, but movement on soil surfaces was harder to represent, largely because the contribution from the fecal deposits tended to be small compared to other sources on erodable soil surfaces. If these high background counts are typical of natural conditions, grazing impacts are probably minimal.
W83-03376

RECOVERY AND TRANSPORT OF HEAVY METALS BY SPARTINA ALTERNIFLORA FROM DREDGING SPOILS,
Rhode Island Univ., Kingston. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 2L.
W83-03381

PHOTOINDUCED HYDROXYLATION REACTIONS OF ORGANIC CHEMICALS IN NATURAL WATERS, NITRATES AS POTENTIAL OH RADICAL SOURCES (PHOTOINDUZIERTE HYDROXYLIERUNGSREAKTIONEN ORGANISCHER CHEMIKALIEN IN NATURLICHEN GEWASSERN, NITRATE ALS POTENTIELLE OH-RADIKALQUELLEN),
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Okologische Chemie.
H. Russi, D. Kotzias, and F. Korte.
Chemosphere, Vol 11, No 10, p 1041-1048, 1982. 2 Fig, 1 Tab, 10 Ref. English summary.

Descriptors: *Organic compounds, *Chemical reactions, Natural waters, *Nitrates, *Solar radiation, Humic acids, Nitrites, Aquatic environment, Free radicals, Hydroxyl radicals, Fate of pollutants, Degradation, Photolysis, Hydrolysis.

Organic chemicals are frequently encountered in natural waters, where they undergo complex reactions under the influence of solar radiation and are catalyzed by substances such as humic acid as well as nitrate and nitrite salts. Nitrates are present in high concentrations in natural waters (5-50 mg/liter). The photolysis of the nitrate ion leads to the formation of OH-radicals. Here the steady-state concentration of OH-radicals in different aquatic environments is estimated (about 5 times 10 to the -16th power mol/liter). It depends upon the amount of nitrate dissolved in the water. Under the conditions in this investigation, the half life for a great number of organic chemicals lies in the range 80-400 hours (for the reaction with OH-radicals). (Author's abstract)
W83-03385

STUDIES OF ACTIVATION PRODUCTS IN THE TERRESTRIAL ENVIRONMENTS OF THREE SWEDISH NUCLEAR POWER STATIONS,
Lund Univ. (Sweden). Dept. of Nuclear Physics.
T. Ingemansson, B. Erlandsson, and S. Mattsson.
Environmental Pollution, Series B, Vol 5, No 1, p 17-33, 1983. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Radioisotopes, *Indicators, *Nuclear powerplants, Cobalt radioisotopes, Zinc radioisotopes, Beryllium radioisotopes, Manganese radioisotopes, Sludge, Fate of pollutants, Powerplants, Simpevarp, Ringhals, Barseback, *Sweden, Air pollution, Vegetation, Lichens, Water pollution sources, Soil.

Sewage sludge collected weekly over 8 months at treatment plants in the vicinity of three Swedish nuclear power stations at Simpevarp, Ringhals, and Barseback were sensitive indicators of radioactive products released into the air. Radionuclides in sludge and in reported controlled releases from the power stations to the air were in the following sequences of decreasing activity concentration: Co60 > Zn65 > Co58 = Mn54. Reported releases of radioactive products to the air were reflected by subsequent increases of radioactive products in sludge. The time variation of activity concentration was reflected better in sludge sedimented from incoming wastewater than in digested sludge from the final treatment phases. The Co58/Co60 activity ratio in sludge was similar to that in releases to the air. Although levels of radionuclides originating in hospitals (Se75 and I131) were unaffected by rainfall, Co60 activity concentrations rose from nondetectable to 55 Bq per kg with the first rain runoff that reached the sewage plant, and then rapidly decreased. Co58 and Co60 levels were much higher in soil than in overlying lichen carpet, whereas Zn65 and Be7 levels were much higher in lichen than in soil. The radionuclide which produced the highest activity concentration in surface air samples was Be7. The Zn65/Co60 activity ratios in sludge and in reported releases to the air and to water were of the same order of magnitude for the three areas studied. This indicates the similar fate of Co60 and Zn65 between reactor and sewage plant. (Cassar-FRC)
W83-03397

CONCENTRATION, REACTIVITY AND FATE OF COPPER, NICKEL, AND ZINC ASSOCIATED WITH A COOLING-WATER PLUME IN ESTUARINE WATERS, II. THE PARTICULATE PHASE,
Connecticut Univ., Groton. Marine Sciences Inst.
D. Waslenchuk.
Environmental Pollution, Series B, Vol 5, No 1, p 59-70, 1983. 3 Fig, 2 Tab, 4 Ref.

Descriptors: *Cooling water, *Particulate matter, *Metals, Fate of pollutants, Copper, Nickel, Zinc, Plumes, Estuaries, *Long Island Sound, Millstone Nuclear Power Plant, Waterford, Connecticut, Powerplants, Corrosion, Suspended,solids, Heavy metals.

Concentrations of particulate phases of metals were studied at 23 stations in Long Island Sound, which receives cooling water discharges from the Millstone Nuclear Power Plant, Waterford, Connecticut. Particulate nickel levels were, for the most part, below the detectable limit. Copper levels (ng per mg) of particulate matter in the water were 6.45 to 19.9 at the intakes, 97.0 at the outlet, 14.6-69.7 in the plume, and 6.3-16.5 at far-field stations. Zinc levels (ng per mg) were 22.7-89.1 at the intakes, 117.5 at the outlet, 37.2-75.0 in the plume, and 39.7-79.5 at far-field stations. Total suspended solids (mg per liter) were 2.73-7.06 at the intakes, 5.35 at the outlet, 3.68-8.67 in the plume and 3.60-6.94 at the far-field stations. Electron microprobe dispersive X-ray analysis showed that the enriched particulates were not metal or oxide flakes from the condenser tubes; rather, grains coated with oxhydroxides or carbonates. The particulate metals concentrations decreased more rapidly in the plume than predicted from temperature dilution. This indicated a repartioning between dissolved and particulate phases, which resulted in excess dissolved copper and zinc in the plume, as confirmed by an earlier study. (Cassar-FRC)
W83-03398

LEAD AND OTHER TRACE METALS IN THE SEDIMENTS AND SELECTED BIOTA OF PRINCESS ROYAL HARBOUR, ALBANY, WESTERN AUSTRALIA,
Western Australia Dept. of Conservation and Environment, Perth.
V. Talbot.
Environmental Pollution, Series B, Vol 5, No 1, p 35-49, 1983. 1 Fig, 4 Tab, 10 Ref.

Descriptors: *Metals, *Lead, *Shellfish, Fate of pollutants, Water pollution sources, Princess Royal Harbor, Albany, *Australia, Heavy metals, Mollusks, Industrial wastes, Sediments, Marine sediments, Phosphates.

Sediment samples and shellfish were collected at 15 sites in Princess Royal Harbor, Albany, Australia, in February 1981 to determine levels of 10 heavy metals (Ag, Cd, Cr, Co, Cu, Fe, Mn, Ni, Pb, and Zn). Elevated levels of metals and organic matter were found in sediments from sites in the vicinity of wharves and food processors. Sources of pollutants were phosphate fertilizer and sulfur spills, antifouling paints, and stormwater runoff from a lead battery processor plant. However, filter-feeding mollusks at these sites contained low levels of metals. In the western part of the harbor, impacted by a superphosphate plant, Pb and F levels exceeded health standards in some mollusk samples. Pb levels in sediments from the western area were in the background range. These results point out the different fates of metals in the same water body. In one case the heavy metals were quickly adsorbed by the sediments and did not contaminate the shellfish. In the western basin the metals were accumulated by the shellfish and did not reach the sediments in significant quantities. It was suggested that the geometric rather than the arithmetic mean should be used to represent heavy metal data in cockles. (Cassar-FRC)
W83-03399

INDUSTRIAL EFFLUENTS AS A SOURCE OF MERCURY CONTAMINATION IN TERRESTRIAL RIPARIAN VERTEBRATES,
Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center.
G. V. N. Powell.
Environmental Pollution, Series B, Vol 5, No 1, p 51-57, 1983. 2 Tab, 28 Ref.

Descriptors: *Mercury, *Food chains, *Birds, Fate of pollutants, Bats, Holston River, *Virginia, Aquatic insects, Insects, Industrial wastes.

Mercury levels in the tissues of birds and bats collected in the summer of 1978 from the North Fork of the Holston River, Virginia, were elevated. A 185 km reach of the river has been contaminated by wastes from a chlor-alkali factory which, from 1954 to 1972, discharged up to 50 kg of mercury per day into the river, plant grounds, and 50 ha of settling ponds. Insectivorous and piscivorous species included green heron, mallard duck, wood duck, rough-winged swallow, eastern phoebe, Louisiana water thrush, red-winged blackbird, song sparrow, and eastern pipistrelle (bat). Mean Hg levels (ppm wet weight) were: 0.05-2.10 in control animals and 0.58-11.40 in animals collected in the contaminated area. Hg levels in aquatic insects were: 0.01-0.2 ppm in control insects and 0.1-2.5 ppm in insects from the contaminated area. These results illustrate the spread of Hg pollutants from one ecosystem to another. (Cassar-FRC)
W83-03402

PRIORITY POLLUTANTS IN MUNICIPAL SEWAGE SLUDGE, PART II,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5E.
W83-03406

DEVELOPMENTS, RECOMMENDATIONS AND APPLICATIONS OF TESTS FOR EVALUATING THE CHEMICAL STABILITY OF HIGH-LEVEL RADIOACTIVE SOLID WASTE FORMS,
North Carolina State Univ. at Raleigh. School of Engineering.
A. G. Solomah.
Environmental Pollution, Series B, Vol 5, No 1, p 9-16, 1983. 2 Fig, 1 Tab, 13 Ref.

Descriptors: *Radioactive wastes, *Hydrogen ion concentration, *Leaching, Fate of pollutants, Waste disposal, Chemical reactions, Solid wastes, Underground waste disposal, Monitoring.

Two factors important in the study of leaching of high-level radioactive wastes buried deep in the ground are: (1) the pH behavior of the leaching medium, and (2) the fractional release of radioactivity to the environment. Several problems associated with pH measurement include variations in temperature, pressure, and carbon dioxide content in the leaching substance (e.g. groundwater). To correct for these conditions it is desirable to use reference solutions, to keep the ratio between volume of solution and inner surface of the container the same in all experiments, and to compensate for temperature and time effects for long leach periods, reaching several years. A plot of the fractional release of a specific element as a function of leaching time can clearly show the leaching behavior of a solid waste under different conditions. (Cassar-FRC)
W83-03427

TRIHALOMETHANE REMOVAL AND FORMATION MECHANISM IN WATER,
Howard Univ., Washington, DC. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5F.
W83-03430

CHEMICAL SPECIATION OF LEACHATES FROM WASTE DISPOSAL SITES,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
G. L. Mullins, and L. E. Sommers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224469, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 158, March 1983. 39 p, 13 Tab, 8 Ref. OWRT A-066-IND(1).

Descriptors: *Leachates, Wastewater, *Wastewater disposal, *Land disposal, Speciation, Inorganic chemicals, Trace metals, Borate complexes, Soils, Groundwater.

Data were obtained from the literature on the fate of inorganic components applied to soils during wastewater irrigation. The chemical composition of wastewater applied and of soil leachates and groundwaters irrigated with wastewater was obtained for six locations in the U.S.; leachate data were also obtained for landfill test cells. Total analytical data for metals and ligands were used as input for an equilibrium chemical model (GEOCHEM) to evaluate metal-ligand species present in the original wastewater and the leachates. The results indicate that wastewaters and leachates contain sodium and potassium as the free metal ion while inorganic complexes with sulfate, phosphate or carbonate are predominant species for calcium and magnesium. The speciation of trace metals was very dependent on the concentration or organic carbon in the solution along with the amounts of inorganic ligands such as borate and phosphate. This study revealed that borate complexes of trace metals (nickel, cadmium, lead, zinc) could be important soluble species in many calcareous soils and groundwaters. Trace metals in the majority of wastewaters and leachates were undersaturated with respect to major solid phases.
W83-03432

ORGANIC MATTER POLLUTION OF GROUNDWATER NEAR HIGHWAYS (BELASTUNG DES GRUNDWASSERS MIT ORGANISCHEN STOFFEN IM GEBIET VON STRASSEN),

Group 5B—Sources Of Pollution

Hessisches Landesamt fuer Bodenforschung, Wiesbaden (Germany, F.R.).
A. Golwer, and W. Schneider.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 7, p 329-342, July, 1982. 2 Fig, 10 Tab, 25 Ref. English abstract.

Descriptors: *Groundwater, Water quality, *Water pollution sources, *Organic compounds, Roads, *Highways, Drainage, Infiltration, Vegetation, Microorganisms, Degradation, Water supply, Fate of pollutants.

Studies were undertaken to determine the influence of organic substances originating from road traffic on the quality of underground water supplies. Three organic parameters, 32 organic group parameters and individual compounds, and an additional 25 selected inorganic major, minor and trace components were determined innumberous water and sludge samples. Road-specific organic pollutants included compounds extractable with petroleum ether or carbon tetrachloride, some volatile aliphatic and aromatic hydrocarbons, polycyclic aromatic hydrocarbons, phenols, anionic surfactants and total cyanides. The organic substances from roads do not spread as far underground as inorganic substances because they are not only diluted, sorbed and partly retained by mechanical filtration on the surface and during underground passage, but they are also degraded by microorganisms. The vegetation of the ground is therefore of decisive importance for protecting groundwater from organic pollution. The study suggests that safety precautions in the area of the study to protect groundwater from drainage of roads may be less extensive than those required in Germany at present. (Baker-FRC)
W83-03446

HEAVY METALS IN FLOWING WATERS AND RIVER SEDIMENTS OF THE WESTERN HARZ REGION (SCHWERMETALLE IN DEN FLIESSGEWASSERN UND FLUSSSEDIMENTEN DES WEST-HARZES,
Thessaloniki Univ., Salonika (Greece). Pollution Control Lab.
K. Fytianos.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 4, p 194-198, April, 1982. 3 Fig, 4 Tab, 11 Ref. English abstract.

Descriptors: *Rivers, *Heavy metals, *Industrial wastes, *Sediments, *Water sampling, Sampling, Water pollution, Water Pollution sources, Lead, Zinc, Copper, Manganese, Nickel, Iron, Atomic absorption spectroscopy, Spectroscopy, X-ray spectroscopy, Harz mountains, Innerste River, Sose River, Sieber River, Federal Repubic of Germany.

The concentration of heavy metals was determined at 21 sites in three rivers of the Harz Mountain area of Northern Germany (Innerste, Sose, and Sieber) during 1978-1979. Also, the heavy metal content of sediments was determined at 11 of the sampling locations. Lead, zinc, copper, manganese, nickel and iron content were determined by X-ray spectrometry, and mercury and cadmium content were determined in sediments using atomic absorptionspectrometry. A direct relationship between suspended metal content and effluent metal content was not found, and only a slight relationship between some metal concentrations and amounts of effluents was indicated. Lead was found rarely, and then in combination with other elements. Zinc was fairly common and did not occcur in combination with other elements. These two metals seem to have different transport mechanisms in water. Levels of copper, nickel and lead were fairly consistent through the test area, while amounts of zinc, iron, and manganese varied widely and seemed dependent on the amounts of industrial wastes. The highest levels of metals were found in the Innerste River water and sediment. In sediment, the relative levels in the Innerste were Pb > Cu, Fe > Zn > Ni > Mn. (Small-FRC)
W83-03457

TRACE ELEMENTS (MANGANESE, ZINC AND COPPER) IN THE USSR PART OF THE DANUBE RIVER,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
Y. P. Nakhshina, L. A. Malinovskaya, I. B. Zubenko, and G. I. Strokatenko.
Hydrobiological Journal, Vol 18, No 1, p 92-96, 1982. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Metals, *Trace metals, *Suspended solids, Rivers, Heavy metals, Manganese, Zinc, Copper, Fate of pollutants, Danube River, *USSR, Black Sea Basin.

Concentrations of dissolved metals in the water of the Soviet segment of the Danube River were surveyed in 1975 and 1977-79. These were (in micrograms per liter): Mn, 0-70; Zn, 3-100; and Cu, 5-59. Zn and Cu reached seasonal peaks in winter and minima in spring and fall and dropped somewhat over the 90 km segment from the Prut mouth to the Ochakov branch of the delta. Suspended matter contained 87-100% of the total Mn, 57-95% of the total Zn, and 40-85% of the total Cu. In 1965 levels of dissolved metals (in micrograms per liter) in the Black Sea Basin rivers were lower: Mn, 0-70; Cu, 0.3-20.1; and Zn, 3.1-43.0. The increase is attributed to increasing contamination by man-made wastes. (Cassar-FRC)
W83-03470

DRINKING WATER CONTAMINATION WITH CHLORO-ORGANIC COMPOUNDS: SOURCES, HEALTH EFFECTS, CONTROL (CONTAMINAZIONE DELLE ACQUE POTABILI DA COMPOSTI CLORO-ORGANICI: ORIGINE, EFFETTI BIOLOGICI, MISURE DI PROTEZIONE E DI CONTROLLO),
Milan Univ. (Italy). Inst. of Hygiene.
For primary bibliographic entry see Field 5F.
W83-03476

MACRO AND TRACE-ELEMENTS IN DRINKING WATER AND FOODS. PART 2 (MACRO ED OLIGOELEMENTI NELL'APPORTO IDRICO ED ALIMENTARE. NOTA 2),
M. G. Pellegrini, M. Cocchioni, R. Riccioni, and F. Tarantini.
Igiene Moderna, Vol 76, No 3, p 483-508, September, 1981, 10 Fig , 4 Tab, 1 Ref. English summary.

Descriptors: *Drinking water, *Trace elements, *Water pollution sources, *Foods, *Water quality, Water pollution, Water analysis, Cadmium, Magnesium, Chromium, Calcium, Cobalt, Copper, Zinc, Lead, Nickel, Maganese, *Italy, Industrial wastes, Chemical analysis, Marches region.

The results of systematic dose-sampling of some macro and trace-elements (Ca, Mg, Cr, Cd, Co, Cu, Zn, Pb, Ni, and Mn) in drinking water in the Marches region of Italy are presented and discussed. The concentrations of these elements in all of the communes considered were below the limits set by the World Health Organization. In Pesaro and Ancona provinces the highest concentrations and most extreme variations were found due to the greater industrial development of these areas. The significance of the role of food for organisms which contain the elements is stressed. The quantities ingested with drinking water represent a low percentage when compared to quantities ingested with foodstuffs, but adsorption from drinking water is much higher than adsorption from food. Determining which elements are ingested and at what quantities is important as well as determining the quantitative relationships between elements and thus mineral imbalances. Correlations between element ingestion and chronic diseases are being studied. (Author's abstract)
W83-03483

VIRAL CONTAMINATION OF SEAWATER AT MESSINA (INQUINAMENTO DI NATURA VIRALE DELLE ACQUE DI MARE DELLA CITTA'DI MESSINA),
Messina Univ. (Italy). Ist. di Igiene.
O. C. Grillo, F. Munao, V. Ciano, I. Picerno, and A. Di Pietro.
Igiene Moderna, Vol 77, No 2, p 228-241, 1982. 1 Fig, 4 Tab, 35 Ref. English summary.

Descriptors: *Viruses, *Feces, *Outfall sewers, *Water analysis, *Mussels, Water pollution sources, Municipal wastes, Urban areas, Seasonal variation, Messina, Ganzirri Lake, *Italy, Lakes.

Virus pollution affects seawater, especially around those urban communities where wastewater is not treated. All of the viruses present in fecal matter are present in untreated sewage. Viruses present in the sewage discharged by the four main sewer outfalls in Messina were investigated. Also, water samples were collected at three sites in Ganzirri Lake where mussels are grown. Insoluble polyelectrolytes, used as coadjuvant in flocculation with aluminum hydroxide, were employed to concentrate the viruses. Virus agents were found at all sampling sites. Thirty-seven viruses were isolated; 16 were polioviruses, 16 were adenoviruses, and 5 could not be identified. Viruses were most prevalent in the spring. Virus pollution of water is significant near the urban area of Messina. The presence of viruses in the lake is particularly dangerous for public health because of the high filtering and concentrating power of mussels. No significant correlation was found between virus and bacterial contamination indicators. (Author's abstract)
W83-03484

5C. Effects Of Pollution

BUFFER CAPACITIES OF FRESH WATER LAKES SENSITIVE TO ACID RAIN DEPOSITION,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
For primary bibliographic entry see Field 2H.
W83-03171

EFFECTS OF SIMULATED ACID RAIN ON YIELDS OF RAPHANUS SATIVUS, LACTUCA SATIVA, TRITICUM AESTIVUM AND MEDICAGO SATIVA,
Brookhaven National Lab., Upton, NY.
L. S. Evans, N. F. Gmur, and D. Mancini.
Environmental and Experimental Botany, Vol 22, No 4, p 445-453, 1982. 2 Fig, 7 Tab, 22 Ref.

Descriptors: *Acid rain, *Crop yield, *Toxicity, Wheat, Alfalfa, Radish, Lettuce, Plant growth, Growth, Inhibition, Water pollution effects.

The effects of simulated acidic rain were determined on several crops grown under greenhouse conditions. Plants were radishes (Raphanus sativus), lettuce (Lactuca sativa), wheat (Triticum aestivum), and alfalfa (Medicago sativa). Simulated rainfalls of pH 5.6, 4.6, 4.2, 3.4, 3.0, and 2.6 decreased root yields of radishes by 26, 42, 37, 41, 66, and 73%, respectively, compared with controls. Similar reductions were seen in radish shoot fresh mass, leaf area, and root diameter. The efficiency of radish foliage in increasing root mass decreased with increased acidity. Lettuce yields (fresh mass) were 11, 10, and 14% less than controls for plants exposed to rainfall of pH 4.0, 3.1, and 2.7, respectively. Rain water of pH 5.7 produced some foliar injury on the outer leaves of lettuce but did not affect marketable quality or yield. Yields of wheat exposed to 46 rainfalls with pH as low as 2.7 during anthesis and caryopsis development were unaffected. Alfalfa showed no differences in fresh mass among treatments even after 57 simulated rainfalls of pH 2.7 water over 105 days. (Cassar-FRC)
W83-03195

TUFA PRECIPITATION AND ITS EFFECT ON DRAINAGE OF INTERSTATE HIGHWAYS IN NORTHEASTERN OHIO,
Kent State Univ., OH. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W83-03213

ECOLOGICAL ASSESSMENT OF WATER QUALITY: COMPARISON OF BIOLOGICAL-ECOLOGICAL PROCEDURES IN A RAIN-FED LOWLAND WATERWAY (KLEINE NETE, N. BELGIUM),

Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
A. Vandelannoote, G. De Gueldre, and B. Bruylants.
Hydrobiological Bulletin, Vol 15, No 3, p 161-164, December, 1981. 1 Tab, 9 Ref.

Descriptors: *Biological properties, *Invertebrates, *Water quality, Benthic fauna, Aquatic life, Streams, Ecology, Kleine Nete River, *Beligium, Water pollution effects, Pollution index.

The correlation between physicochemical water quality parameters and invertebrate populations was determined from 58 samples collected in April and September 1977 and April 1978 from 23 brooks in the Kleine Nete River Basin, Belgium, a rainfed lowland waterway with extreme variations in flow. The Gardeniers-Tolkamp (1976) indexes, based on the Moller Pillot (1971) saprobic system, were most suitable for assessing organic water quality of the brooks under study. The Woodiwiss (1964) and Tuffery-Verneaux (1968) biotic indexes were unsuitable because of overestimation of water quality at low flow and underestimation in oligothrophic and slightly polluted reaches. The variety indexes of Margalef, Menhinick, and Odum-Cantlon-Kornicker were not applicable for assessment of biological water quality for similar reasons. (Cassar-FRC)
W83-03214

THE INFLUENCE OF MICRO-ALGAE ON THE OXYGEN DYNAMICS IN A BRACKISH DITCH,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
J. W. Rijstenbil, and A. G. A. Merks.
Hydrobiological Bulletin, Vol 15, No 3, p 123-135, December, 1981. 13 Fig, 5 Tab, 23 Ref.

Descriptors: *Oxygen, *Algae, *Seasonal variation, Dissolved oxygen, Ditches, Brackish water, Saline water, Adriaan Polder, *Netherlands, Photosynthesis, Diurnal variation, Chlorophyll, Benthic flora, Phytoplankton, Migration, Ice cover.

Seasonal changes in phytoplankton and benthic algae activity relative to diurnal oxygen changes were studied in a 120 cm deep, 12 m wide drainage ditch in Adriaan Polder, the Netherlands, a brackish, hypertrophic ditch. Oxygen gradients were unstable, depending on the chloride gradient and wind velocity. In summer diatoms produced surface oxygen maxima at light saturation in late afternoon. At the same time flagellates produced oxygen in dim light, choosing their suitable light conditions by vertical migration. Oxygen levels fluctuated from 0 to 34 mg per liter in a 100 cm vertical profile above a 20 cm anoxic layer. The widest range of diurnal fluctuations in oxygen concentration maxima was seen in summer, 10 to 34 mg per liter. In winter only about 6-8% of surface light energy reached the bottom. In daytime the oxygen gradient was reversed because benthic algae produced oxygen on the bottom. About noon 1 mg per liter per hour of oxygen was produced in a 10 cm water layer above the bottom. Vertical oxygen transport appeared to be blocked below 60 m over the sediment. (Cassar-FRC)
W83-03215

SALINE SEEPAGE AND VERTICAL DISTRIBUTION OF OXYGEN IN A BRACKISH DITCH,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
A. G. A. Merks, and J. W. Rijstenbil.
Hydrobiological Bulletin, Vol 15, No 3, p 111-121, December, 1981. 16 Fig, 11 Ref.

Descriptors: *Seepage, *Oxygen demand, *Anaerobic conditions, Ditches, Fate of pollutants, Brackish water, Polders, Drainage ditches, Saline water, Dissolved oxygen, Lake Veere, Adriaan Polder, *Netherlands, Chlorides, Bottom sediments, Stratification, Algae, Water quality control.

Saline seepage into drainage ditches and its effects on oxygen concentrations were studied in the laboratory and in a 120 cm deep, 12 m wide ditch in the Adriaan Polder near Lake Veere, the Netherlands. In summer when the level of Lake Veere was raised by 70 cm, seepage into the ditch 6-10 mm per hour was observed. The seepage contained chlorides, sulfides, and manganese and ferrous ions, forming a vertical oxygen gradient and an anoxic layer. Bottom oxygen demand was 2.0 g 02 per sq m per hour. During winter when the lake level was lowered, seepage stopped, and chloride entered the water by diffusion from the mud, which decreased in chlorinity from 15 to 3 o/oo. When the ditch level sank below the lake level for short periods during this season, seepage immediately restored the chlorinity in the ditch. Oxygen requirements were 1.42 g 02 per sq m per hour. In the laboratory simulations a seepage velocity of 1mm per hour corresponded with an oxygen demand of 0.05 g per sq m per hour. Extremely fast seepage caused a bottom oxygen uptake that exceeded the algal oxygen production. The bottom oxygen demand then reached a maximum when the dissolved oxygen was depleted. To prevent seepage and anoxic conditions the lake should be maintained below the ditch level in summer as well as in winter. (Cassar-FRC)
W83-03216

FISH FARM EFFLUENTS--CAUSE FOR CONCERN,
For primary bibliographic entry see Field 5B.
W83-03237

THE RESPONSES OF PLANKTON COMMUNITIES IN EXPERIMENTAL PONDS TO ATRAZINE, THE MOST HEAVILY USED PESTICIDE IN THE UNITED STATES,
Kansas Univ., Lawrence. Dept. of Systematics and Ecology.
F. DeNoyelles, W. D. Kettle, and D. E. Sinn.
Ecology, Vol 63, No 5, p 1285-1293, 1982. 2 Fig, 4 Tab, 36 Ref. OWRT A-092-KAN.

Descriptors: *Plankton, *Water pollution effects, *Pesticides, Organic compounds, Agricultural chemicals, *Atrazine, Population dynamics, Ponds, Photosynthesis, Phytoplankton, Zooplankton, Kansas.

Experimental ponds received single additions of atrazine in concentrations of 20 and 500 micrograms/liter, and were compared to control ponds for 136 days. Atrazine at each concentration depressed phytoplankton growth in the ponds within a few days. This was followed by successional changes leading to the establishment of species of phytoplankton more resistant to inhibition by atrazine. Laboratory studies verified this resistance and verified effects on other species at concentrations of atrazine as low as 1 to 5 micrograms/liter. At the concentration of 500 micrograms/liter there was a delayed appearance but eventually a greater biomass and persistence of resistant species than at lower concentrations. Natural interactions such as competition and predation among the species of the communities greatly affected their responses to the toxic chemical. The importance of atrazine as an environmental pollutant is suggested by these responses to concentrations of 1 to 5 microgram/liter, which are commonly found downstream from agricultural lands, and 20 micrograms/liter, which is the highest level usually found in such waters. The level of 500 micrograms/liter is found in waters directly adjacent to treated field. (Baker-FRC)
W83-03255

STUDY OF THE CHANGES IN RIVER WATER QUALITY (ETUDE DE L'EVOLUTION DE LA QUALITE DES EAUX DE RIVIERE),
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
For primary bibliographic entry see Field 5B.
W83-03267

AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF CRUDE OIL ON TWO FRESHWATER LAKE ECOSYSTEMS,
Utah Water Research Lab., Logan.
M. D. Werner, V. D. Adams, and V. A. Lamarra.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219774, Price codes: A10 in paper copy, A01 in microfiche. Utah Water Research Laboratory Water Quality Series UWRL/Q-83/04, April 1983. 218 p, 49 Fig, 41 Tab, 173 Ref, 12 Append. OWRT B-187-UTAH(1), 14-34-0001-0253.

Descriptors: Lakes, *Ogliotrophic lakes, Lake sediments, *Oil pollution, Oil, Oil spills, Microcosms, Nutrient immobilization, *Ecosystems litter, *Aquatic environment, Aquatic habitats, Wind, Biochemical oxygen demand, Decomposition, Utah, Idaho, Wyoming, Lake ecosystems.

The responses of two freshwater lake ecosystems (Bear Lake, Utah-Idaho, and New Fork Lake, Wyoming) to crude oil impaction were investigated in two phases. The effects were first studied on three phase (gaseous-aqueous-sediment) laboratory microcosms. Notable responses were increased oxygen demand, nutrient immobilization, reduction in plant biomass accumulation, and a heterotrophically dominated ecosystem. The increased availability of biologically degradable carbon (the oil) and nutrient immobilization dominated any toxic effects as the primary contributors to a long-term imbalance between autotrophs and heterotrophs. The second phase investigated the effects of crude oil on plant litter decomposition in the lakes. In general, crude oil reduced in situ litter decomposition, but as an annual average the activity of oil-litter associated decomposer communities was enhanced. Differences in impacts between litter types and lakes were explained by differences in biochemical structures of the plants, sediment types of the lakes, and wind over the lakes. Increased rates of oxygen utilization induced by the crude oil were identified as the potential primary detrimental effect of oil pollution. Crude oil did not affect the nutrient content of plant litter, but the rate of nutrient loss was reduced. Nitrogen limitation may have been the primary factor reducing the rate of oiled litter decomposition.
W83-03273

A STUDY OF EUTROPHICATION AND AQUATIC PLANTS GROWTHS IN SELECTED LAKES AND RIVERS OF PUERTO RICO,
Puerto Rico Univ., Mayaguez. Quality Control Lab.
E. Negron.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220376, Price codes: A03 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Univ. of Puerto Rico, Mayaguez, March 1983. 24 p, 12 Tab, 11 Ref. OWRT A-071-PR(1), 14-34-0001-1141.

Descriptors: *Eutrophication, *Lakes, Aquatic plants, Nutrients, Sediments, *Puerto Rico, Rivers, *Aquatic plant growth, Cations, Nitrogen, Phosphorus, Reservoirs.

This study was conducted to identify the physical and chemical parameters which promote eutrophication and aquatic plants growths in the lakes of Puerto Rico. Five lakes were considered, all of them man-made reservoirs. The results showed that lakes with visible states of eutrophy had a cation ratio between 0.74 and 1.45, whereas those with no visible state of eutrophy had a cation ratio of 0.15-0.35. Nutrient enrichment was present in the eutrophic lakes, and all the sediments were enriched with nitrogen and phosphorus. The nitrogen was present in the organic form rather than as ammonia compounds. (Munoz, Puerto Rico).
W83-03300

EFFECTS OF COAL PILE RUNOFF ON STREAM QUALITY AND MACRO-INVERTEBRATE COMMUNITIES,
Maryland Univ., Frostburg. Appalachian Environmental Lab.
M. C. Swift.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220541, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Technical Report No 68, Univ. of Maryland, College Park,

September 1982. 50 p, 1 Fig, 13 Tab, 21 Ref, 2 Append. OWRT A-062-MD(1), 14-34-0001-2122.

Descriptors: *Coal pile leachate, Coal drainage, Water pollution effects, *Maryland, Georges Creek, *Mine drainage, Benthos, *Leachate, Coal pile runoff, *Pollutant identification, Water analysis, Invertebrates.

Samples of coal pile runoff and Georges Creek water and macrobenthos above and below two coal storage areas along Georges Creek, Allegheny County, Maryland, were collected during summer, fall and winter, 1982-1983. Coal pile runoff was collected under high and low flow conditions. Water samples were analyzed for Hg, Zn, As, Fe, Mn, Al, S0 super -2 sub 4, pH, filterable and nonfilterable residue, conductivity and acidity. Leachate from coal piles along Georges Creek contains high concentrations of heavy metals, particularly manganese, aluminum, and zinc. Iron and sulfate are very high and the pH ranges from 1.4 to 3.1. Because of dilution, Georges Creek water has much lower concentrations of metals, iron and sulfate and a pH of about 7.0. The distribution of macrobenthos in Georges Creek shows the effects of both runoff from coal storage piles and periodic drought. Brillouin's diversity index values were low even in areas which did not dry up. Densities of tubificid worms and chironomid larvae were very high above the coal storage areas where organic inputs were high. At all the rest of the sampling stations, macroinvertebrate densities were very low. Where coal pile runoff enters Georges Creek, it compounds the effects of periodic drought and further stresses the aquatic community.
W83-03307

RADON-222 IN POTABLE WATER SUPPLIES IN MAINE: THE GEOLOGY, HYDROLOGY, PHYSICS AND HEALTH EFFECTS,
Maine Univ. at Orono. Land and Water Resources Center.
For primary bibliographic entry see Field 2K.
W83-03308

THE BIOLOGICAL REGULATION OF BLOOM-CAUSING BLUE-GREEN ALGAE: A FEASIBLE ALTERNATIVE,
Nebraska Univ., Lincoln. School of Life Sciences.
E. L. Martin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220574, Price codes: A03 in paper copy, A01 in microfiche. Nebraska Water Resources Center Completion Report, Univ. of Nebraska, Lincoln June 1982. 36 p, 11 Fig, 4 Tab, 46 Ref. OWRT A-056-NEB(1), 14-31-0001-9029.

Descriptors: *Cyanophyta, *Eutrophication, *Algal control, Bacteriophage, Biocontrol, Bacteria, Water quality, Aquatic microbiology, *Nebraska, Oscillatoria, Microcystis, Anabaena, Aphanizomenon.

The Army Corps of Engineers has constructed a group of flood control lakes in eastern Nebraska. Frequently, these lakes receive large amounts of inorganic nutrients (e.g., nitrates, phosphates) from runoff waters containing such agricultural materials as fertilizers and animal wastes. In the summer and early fall, these nutrients often cause a tremendous increase in water productivity exemplified by large blooms involving predominantly the blue-green algae strains Oscillatoria, Microcystis, Anabaena and Aphanizomenon. The initial focus of the project involved isolation and characterization of the bloom-forming strains of blue-green algae. Closely related to this was the isolation and characterization of appropriate biological regulatory agents (bacteria and viruses). Considerable effort was additionally spent on elucidating how the biological regulatory agents were able to specifically destroy their blue-green algal hosts. Laboratory microcosm studies were run in which the various biological control agents were able to rapidly lyse small 'blooms' (e.g. 1 and 2 liters) of the respective blue-green algal strains. These experiments were then extended to field trials in selected lakes (Pawnee and Twin Lakes) in the Salt Valley Watershed. Enclosures containing about 20 gallons were erected in the water near the shore. Some success was attained by our biological control agents in lysing both real and simulated blue-green algal blooms.
W83-03311

THE EFFECT OF HORMONAL POLLUTANTS ON AQUATIC CRUSTACEA AND THE SURROUNDING ENVIRONMENT,
Connecticut Univ., Storrs. Inst. of Water Resources.
H. Laufer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220582, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, December 1982. 38 p, 12 Fig, 5 Tab, 9 Ref. OWRT A-083-CONN(1), 14-34-0001-9007.

Descriptors: Pesticides, *Insecticides, *Insect control, Aquatic insects, *Arthropods, *Insect growth regulations, Carcinus meanas, *Hepatopancreas, Water pollution sources, Water pollution effects.

The impact of administering compounds which have hormonal activity on insects was evaluated on crustacea. The Juvenile Hormone Analog (JHA) Methoprene and its formulation, Altosid, were tested as were other compounds with specific insecticidal effects, such as Insect Growth Regulators (IGRs). Lethal levels of Methoprene (Altosid) were established. Sublethal levels affect reproduction and embryonic development. Safe concentrations of Methoprene and Precocene were found. Dimilin was more toxic to Daphnia than to target insects (1X10 super -9M). The results suggest that applications of specific IGRs to the environment could upset the biological food chain and thereby result in major pollution problems as well as the destruction of an aquatic ecosystem. The information should warn users of IGRs of potential hazards to an aquatic ecosystem. To provide new means for studying aspects of crustacean reproduction and its control, we have initiated short term organ culture procedures. Conditions for cultivating fragments of Carcinus meanas hepatopancreas were established. This tissue is capable of synthesizing yolk protein precursors, vitellogenins. Interstitial cells of the hepatopancreas were identified as the source of vitellogenins by the use of immunocytological localization. The production of yolk proteins seems to be hormonally regulated and sensitive to IGRs.
W83-03314

EFFECTS OF SEWAGE POLLUTION IN THE WHITE RIVER, ARKANSAS ON BENTHOS AND LEAF DETRITUS DECOMPOSITION,
Arkansas Univ., Fayetteville.
A. V. Brown, L. D. Willis, and P. P. Brussock.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222216, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 97, Univ. of Arkansas, Fayetteville, May 1983. 28 p, 3 Fig, 3 Tab, 43 Ref. OWRT A-058-ARK(1), 14-34-0001-2104.

Descriptors: *Stream pollution, *Detritus, *Decomposition, *Benthos, Physiochemical properties, Fish, Water pollution effects, White River, *Arkansas, City planning, Fayetteville, Effluent discharge.

Recently there has been much emphasis placed on the importance of leaf detritus processing to the energetics of stream invertebrates. This study was designed primarily to assess the effects of municipal effluent on the ability of a stream community to utilize leaf detritus, and secondarily to evaluate the extent of pollution of the White River by the Fayetteville, Arkansas effluent discharge. Physical and chemical water quality, benthos, and fish were sampled periodically at one station upstream and two stations downstream from the discharge, and in the Richland Creek tributary. Processing of leaf detritus was studied at each site using 5 g packs of red oak (Quercus shumardi) leaves. Dissolved oxygen was far below recommended levels which resulted in a fish kill. Substantial increases in orthophosphate, ammonia, chlorides, conductivity, and turbidity were observed downstream. Only 1 fish species (Morone chrysops) was collected downstream as it migrated through. The pattern of benthic species (25 immediately upstream, 8 just downstream, 17 downstream 8 km and 20 in tributary) indicated heavy pollution. Despite this, leaf detritus processing rates were extremely rapid (K = 0.01-0.03) indicating that leaf decomposition is virtually unaffected by macroinvertebrates.
W83-03332

A SURVEY OF WATER TRANSPARENCY IN IOWA LAKES,
Iowa State Univ., Ames. Dept. of Animal Ecology.
J. R. Jones, and R. W. Bachmann.
Proceedings, Iowa Academy of Sciences, Vol 85, No 1, 1978, p 6-9. 4 Fig, 1 Tab, 8 Ref. OWRT A-049-IA(4).

Descriptors: Eutrophication, *Iowa, Lakes, Water quality, Water transparency, *Secchi depth, Survey, Pollutant identification.

Measurements of Secchi disk transparency were made in 50 Iowa lakes and reservoirs in the summer of 1975. Averages of July and August readings for individual lakes ranged from 0.1 to 2.7 m. The man-made lakes in the southern part of the state generally had greater transparencies than the natural lakes in the north. Reduced transparency was related more to algal density than to suspended inorganic matter.
W83-03371

CHANGES IN ESTERASE ZYMOGRAMS OF A PLANKTONIC COPEPOD, ACARTIA CLAUSI, IN A POLLUTED MARINE AREA (SEWAGE OUTPUT OF MARSEILLES) (MODIFICATIONS DES ZYMOGRAMMES DES ESTERASES D'UN COPEPODE PLANCTONIQUE, ACARTIA CLAUSI DANS UNE EMISSAIRE DE MARSEILLE),
Centre Universitaire de Luminy, Marseille (France).
P. Kerambrun, and D. Riviere.
Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, Serie 3, Vol 294, No 18, p 929-932, May 1982. 1 Fig, 12 Ref. English summary.

Descriptors: *Water pollution effects, *Municipal wastewater, Gulf of Marseilles, Zymograms, Copepods, Toxicity, *Esterase, Microorganisms, Wastewater disposal, Ocean outfalls, Wastewater pollution, *France.

Esterase activity was revealed after polyacrylamide gel electrophoresis of population samples of the copepod Acartia clausi from 5 stations in the sewage outfall area of Marseilles. Zymograms were compared to those of A. clausi from an area of the Gulf of Marseilles considered as non-polluted. Results show that the urban pollution, mainly organic, had caused changes in the relative activity of the different fractions in the moderately polluted stations, and a clear decrease in the activity of all the fractions in the most polluted station. These variations are the visible results of the physiological response of the organisms to the ecological disturbance: when it remains moderate, adjustment is possible. When it is too great, adjustment does not occur. (Baker-FRC)
W83-03386

HYGIENIC EVALUATION OF HYDROGEN SULFIDE-CONTAINING THERMAL WATERS USED IN HOT WATER SUPPLY SYSTEMS (GIGIENA OTSENKA SEROVODNYKH TERMAL'NYKH VOD, ISPOL'ZUEMYKH V SISTEME GORYACHEGO VODOSNABZHENIYA),
Sanitarno-Gigienicheskii Inst., Tiflis (USSR).
T. A. Beruashvili.
Gigiena i Sanitariya, No 6, p 11-13, 1980. 1 Tab, 5 Ref. English summary.

Descriptors: *Chemical analysis, *Thermal water, *Hydrogen sulfide, *Toxicity, *Laboratory animals, Water analysis, Water quality, Water pollution effects, Public health, *USSR.

The chemical characteristics of waters from hot springs used to supply the population of Tbilisi (Tiflis, Georgia, USSR) were determined, and recommendations for the safe and effective use of these waters were formulated. In toxicological studies on laboratory animals, water containing 3 mg/liter of hydrogen sulfide had no adverse effect on the animals. Water containing 4 to 6 mg/liter of hydrogen sulfide had a slight biologic effect, and that with a concentration from 10 to 12 mg/liter had toxic effects both when ingested and when applied to the skin. (Author's abstract)
W83-03405

THE EFFECT OF AUFWUCHS COPPER ON SPAT SETTLEMENT OF THE OYSTER, CRASSOSTREA VIRGINICA,
District of Columbia Univ., Washington. Dept. of Biology.
H. L. Phelps.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224444, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Report No 47, Univ. of the District of Columbia, June 1983. 41 p, 12 Fig, 2 Tab, 25 Ref, 3 Append. OWRT A-010-DC(1), 14-34-0001-1109.

Descriptors: *Oyster larvae, *Spatfall, *Aufwuchs, *Copper, *Chesapeake Bay, Water pollution effects, Metals, Pollutant identification, Spectroscopy.

Studies on the recent failure of oyster spatfall in the Chesapeake Bay have led to speculation of an unknown toxic factor at the setting site. Oyster larvae set on oyster shell surfaces normally covered with aufwuchs which may have the capacity to bind toxic metals such as copper. Over 200 oysters were collected from six mid-Chesapeake Bay sites paired for high and low spatfall. Aufwuchs samples and oyster tissue analysis indicated no significant difference in copper concentrations between paired sites. In the laboratory, aufwuchs concentrated copper from enriched estuarine water up to 20 times ambient levels in one hour, and failed to depurate copper over two hours, unlike agar (a neutral polysaccharide). Oyster larvae raised to setting stage from a single maternal spawn were exposed to copper-enriched aufwuchs surfaces. The number of larvae setting on aufwuchs surface vs clean (Inner shell) surface decreased significantly with increasing copper in aufwuchs above 100 ug Cu/gm wet weight. Failure of larval metamorphosis ranged from 0% (5 ug Cu/gm wet weight aufwuchs, control) to 81% (760 ug/gm) but was significant only above 100 ug/gm. Since mid-Bay aufwuchs samples average 35.5 ug/gm, ranging up to 103. ug/gm, it is unlikely that present levels are affecting oyster spatfall.
W83-03429

NUTRIENT CONTENTS AND ALGAL GROWTH IN AN IMPOUNDED RIVER: EFFECTS ON OXYGEN BALANCE AND NEED FOR NUTRIENT RETENTION (NAHRSTOFFGEHALTE UND ALGENWACHSTUM IN EINEM GESTAUTEN FLUSS, AUSWIRKUNGEN AUF DIE SAUERSTOFFBILANZ UND NOTWENDIGKEIT DES NAHRSTOFFRUCKHALTES),
K. R. Imhoff, and D. R. Albrecht.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 3, p 140-146, March, 1982. 11 Fig, 2 Tab, 10 Ref. English abstract.

Descriptors: *Eutrophication, *Algae, *Oxygen demand, *Phosphorus, *Rivers, Nitrogren, Organic carbon, Aeration, Reservoirs, Low flow, Algal growth, River flow, Decomposition, Algae control, Model studies, Mathematical models, Ruhr River, Federal Republic of Germany.

A series of impoundments occur on the final 46 km stretch of the Ruhr River where phosphorous, nitrogen, and organic carbon are abundant, causing several heavy algal blooms during the year. This bloom has a detrimental effect on the capacity of the treatment works. Also, an oxygen shortage is always recorded in the river after algal decay at low flows, thus necessitating artificial aeration. By balancing all oxygen supply and consumption, it is shown that about two thirds of the oxygen demand is due to algal decomposition. When water quality of the past 30 years and the results of special laboratory tests are evaluated, results show that phosphates initiate algal growth. Therefore, a phosphate model was developed for the river, which predicts the phosphate content for 1988 and 1998. If phosphate content is reduced, algal growth can be cut by 50%. (Author's abstract)
W83-03454

IDENTIFICATION OF THE WATER QUALITY FACTORS WHICH PREVENT FINGERNAIL CLAMS FROM RECOLONIZING THE ILLINOIS RIVER, PHASE III,
Illinois Natural History Survey, Havana. River Research Lab.
R. E. Sparks, M. J. Sandusky, and A. A. Paparo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-226837, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center Research Report No 179, University of Illinois, Urbana, April 1983. 63 p, 16 Fig, 15 Tab, 26 Ref. OWRT B-124-ILL(1), 14-34-0001-0217.

Descriptors: Fingernail clams, Sphaerium transversum, Musculium transversum, Sphaeriidae, Silt, Ammonia, Suspended solids, Suspended sediment, Keokuk pool, Mississippi river, *Illinois river, *Pollutant identification, Toxicity, *Clams, *Mussels, *Mollusks, Bivalves, Fluoride, Cadmium, Lead, Metals, *Illinois, Water pollution effects.

The purpose of this research was to determine why fingernail clams have been unable to recolonize a 100-mile reach of the Illinois River where they were abundant prior to a die-off in the 1950's. Fingernaiil clams are major links in food chains leading from detritus and algae to higher level consumers valued by man, such as fish and water fowl. Three suspected toxicants--fluoride, lead and cadmium--and sediments from the reach where the die-off occurred were tested on intact fingernail clams (Musculium transversum) and gill preparations isolated from the clams. Results indicate that the sublethal response exhibited by the gills to fluoride is at least four times more sensitive than the lethal response. Maximum fluoride concentrations reported by the U.S. Geological Survey at two stations in the Illinois River are considerably below concentrations that affected growth and survival of intact clams but slightly above the level that affected isolated clam gills. The results of the land bioassays were ambiguous and additional bioassays are needed. The results of the gill assay suggest that sediments in the Illinois River contain unidentified toxic factors and that sediments in the upper river, closer to the metropolitan areas of Joliet and Chicago, are more toxic than sediments further downstream.
W83-03463

TENDENCIES IN THE CHANGES IN THE SAPROBIC CONDITIONS OF THE MARITSA RIVER (TENDENTSII V IZMENENYATA NA SAPROBIOLODGICHNOTO SUSTOYANIE NA REKA MARITSA),
Bulgarian Academy of Sciences, Sofia.
B. K. Russev, J. I. Uzunov, S. G. Kovachev, I. Y. Yaneva, and L. S. Ivanova.
Khidrobiologia (Sofia), Vol 14, p 51-64, June, 1981. 4 Fig, 10 Ref. English summary.

Descriptors: *Saprophytic bacteria, *Eutrophication, *Aquatic productivity, *Water analysis, *Water pollution effects, Industrial wastes, Toxicity, River, Organic wastes, Water pollution, Maritsa River, Bacteria, *Bulgaria.

The hydrochemical and saprobiological conditions in the Maritsa River were investigated during 1976 and 1977. Five sections were distinguished based on pollution level. The first was Raduil through Kostenets, which had xeno- and oligosaprobity upstream and beta-m-saprobity. From Kostenets through Pazarjik was polluted with toxicants which killed the fauna and obscured the saprobic process. From Pazaejik to Popovitsa was primarily polluted with organic wastes, with a saprobity between alpha-m and beta-m-saprobity. There was active self-purification in the fourth section, from Popovitsa through Dimitrovgrad. Dimitrovgrad through Kapitan Andreevo is polluted with industrial wastes input via the Sazliika river. There are limnotranssaprobic as well as toxic conditions in the river. A study of the saprobic conditions in the Maritsa River in 1955, 1964-1966, and 1976-1977 revealed a gradual deterioration in water quality. A goal of maintaining biological equilibrium and favorable self-purification conditions is recommended for the entire river. Construction of water purification stations is recommended. (Small-FRC)
W83-03473

SPECIES COMPOSITION AND DISTRIBUTION OF THE MACROZOOBENTHOS OF THE MARITSA RIVER (VIDOV SUSTAV I RAZPREDELENIE NA MAKROZOOBENTOSA OT REKA MARITSA),
Bulgarian Academy of Sciences, Sofia.
J. I. Uzunov, B. K. Rusev, S. G. Kovachev, and I. Y. Yaneva,.
Khidrobiologia (Sofia), Vol 14, p 3-15, June, 1981. 1 Tab, 6 Ref. English summary.

Descriptors: *Aquatic productivity, *Population density, River, *Water pollution effects, *Aquatic animals, Oligochaetes, Insects, Caddisflies, Water analysis, Water pollution, Maritsa River, *Bulgaria.

The macrozoobenthos of the Maritsa River was studied in 1976-1977. Two hundred and twenty-nine species belonging to 130 genera were established. Representation was: 23.6% Oligochaeta, 19.6% Ephemeroptera, 10.9% Simuliidae, 10.9% Coleoptera, and 7.4% Trichoptera. Species distribution along the stream is reported and discussed. The analysis of the changes in species composition over the recent 10 to 15 years showed gradual alterations in bottom communities, with elimination of some species and introduction of others. The similarities in fauna populations established in this study and by Rusev (1966-1967) amounted to 46.1%. Seventy-six species were eliminated from the list of zoobenthic species known in 1955 and 55 species from Rusev's 1966 list. Considerable differences were found in the species composition of some sampling stations that had fairly similar results in 1955 and 1966. The changes in species composition and distribution along the river are probably due to the effects of increased industrialization and urbanization on water chemistry and thus on river biota. (Author's abstract)
W83-03474

THE SPECIES DEFICIT OF THE MACROZOOBENTHIC COMMUNITIES AS A CRITERION FOR THE TRANSSAPROBIC INFLUENCES ON THE MARITSA RIVER (VIDOVIYAT DEFITSIT NA MAKROZOOBENTOSNITE SUOBSHCHESTVA KATO KRITERII ZA TRANSSAPROBNITE VLIYANIYA VURKHU REKA MARITSA),
S. G. Kovachev, and J. I. Uzunov.
Khidrobiologia (Sofia), Vol 14, p 75-80, June, 1981. 3 Fig, 8 Ref. English summary.

Descriptors: *Saprophytic bacteria, *Eutrophication, Rivers, *Aquatic productivity, *Water pollution effects, Population density, Population dynamics, Microorganisms, Correlation analysis, Statistical analysis, Maritsa River, Water pollution, *Bulgaria.

The species deficit index was determined simultaneously with the saprobiological characteristics in order to establish both toxic and inert transsaprobic influences in the Maritsa River. These influences were very strong at two points: downstream from Belovo and downstream from Dimitrovgrad. No significant correlation was established between the curves of the saprobiological conditions and the species deficit under the conditions of slight or moderate pollution. Where there were strong transsaprobic influence, the species deficit values rose sharply and became a necessary part of the saprobiological analysis. (Author's abstract)
W83-03475

MACRO AND TRACE-ELEMENTS IN DRINKING WATER AND FOODS. PART 2 (MACRO ED OLIGOELEMENTI NELL'APPORTO IDRICO ED ALIMENTARE. NOTA 2),
For primary bibliographic entry see Field 5B.
W83-03483

5D. Waste Treatment Processes

CHEMOSTAT ADAPTATION OF ESCHERICHIA COLI B/R/1 TO LOW WATER ACTIVITY,
Queen Elizabeth Coll., London (England). Dept. of Microbiology.
G. D. Anagnostopoulos, and G. Dhavises.
Journal of Applied Bacteriology, Vol 53, No 2, p 173-177, October, 1982. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Escherichia coli, *Sodium chloride, *Osmotic pressure, *Batch culture, Enteric bacteria, *Wastewater treatment, Biomass, Osmosis, Culturing techniques, Cations.

Potassium ion-dependent osmotic adjustments in non-penetrant solute systems should require considerable energy expenditure for potassium ion uptake and electrical compensation. If such a mechanism prevailed in non-penetrant solute batch systems, the maintenance energy requirements could be partly responsible for growth impairment of Escherichia coli B/r/1 under conditions of hypertonicity. Previous studies have shown that E. coli grown in a chemostat at a reduced water activity tend to accumulate glucose independently of the dilution rate used. Chemostat cultures of E. coli under conditions of glucose limitation in a salts medium at high water activity (0.999) and at a water activity of 0.987 controlled by sodium chloride were compared. Dilution rates above 0.035/hr were used. Results suggested that E. coli adapted to the lower water activity of the medium because no significant change was observed in the energy requirement for maintenance, even though the maximum molar growth yield for glucose decreased by 23.2%. Such cultures also exhibited a shorter lag and higher growth rate in batch systems at a water activity of 0.987 compared with cultures started with an unadapted inoculum. (Geiger-FRC)
W83-03151

THE REMOVAL OF SALMONELLA ENTERITIDIS IN ACTIVATED SLUDGE,
M. I. Yaziz, and B. J. Lloyd.
Journal of Applied Bacteriology, Vol 53, No 2, p 169-172, October, 1982. 2 Fig, 10 Ref.

Descriptors: *Salmonella, *Wastewater treatment, *Activated sludge process, *Model studies, *Separation techniques, Activated sludge, Enteric bacteria, Protozoa, Adsorption, Flocculation.

The mechanisms and efficiency of the removal of salmonellae in a laboratory model of the activated sludge process were examined under batch process conditions. Results showed that the removal of salmonellae occurred in three phases. In 4 hr, 90% of the original Salmonella enteritidis inocullum disappeared from the activated sludge mainly because of predation by ciliated protozoa. The remaining 10% was distributed between the liquid phase and sludge floc. During the next 2 hr more than 80% of the remaining salmonellae were then adsorbed to the floc, leaving less than 20% in liquid suspension. After 6 hr there was a slower decline of the remaining salmonellas attached to the floc. The addition of dioctyl sodium sulfosuccinate after 4 hr inactivated the ciliated protozoa population and eliminated the continued reduction of salmonellae from the activated sludge. (Geiger-FRC)
W83-03152

FATE OF NITROGEN AND PHOSPHORUS IN A WASTE-WATER RETENTION RESERVOIR CONTAINING AQUATIC MACROPHYTES,
Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy.
Journal of Environmental Quality, Vol 12, No 1, p 137-141, January/March, 1983. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Nutrients, *Aquatic plants, *Detention reservoirs, Wastewater treatment, Nitrogen removal, Phosphorus removal, Macrophytes, Agricultural wastes, Ammonium, Nitrates, Denitrification, Accumulation, Bioaccumulation.

The effects of aquatic macrophytes on retention of nutrients from agricultural drainage effluents were studied in tub-sized systems stocked with: (1) pennywort, (2) water hyacinth, (3) cattails and elodea, and (4) no macrophytes (control). In a 27 day detention period plants removed 41-67% of added ammonium and 13-24% of added nitrate; 45-52% of the added N was unaccounted for (lost through ammonia volatilization and denitrification). In the control system algae removed 4.6% of added ammonium and 4.3% of added nitrate; 54% of ammonium and 29% of nitrate were unaccounted for. All systems removed 100% of the ammonium in <6 days. The N removal rate constants (per day) were: pennywort, 0.188; cattail-elodea, 0.184; water hyacinth, 0.039; and control, 0.025. To remove 50% of added N, pennywort and cattail-elodea systems required 4 days; water hyacinth, 18 days; and the control, 28 days. Plant removal of added P was 3-65%, with 7-87% lost by precipitation and adsorption. (Cassar-FRC)
W83-03154

MANAGEMENT OF HUMAN EXCRETA,
Z. -X. LU, G. -Y. Qiang, and X. -D. Dai.
American Journal of Public Health, Vol 72 Supplement, No 9, p 52-53, September, 1982. 1 Ref.

Descriptors: *Anaerobic digestion, *Parasites, *Public health, Wastewater treatment, Fermentation, Digestion, Diseases, Human diseases, Schistosomiasis, Sanitation, Waste disposal, *China.

Widespread incidence of waterborne diseases in the Chinese countryside led to the development of excreta management techniques to minimize pollution of rivers used as drinking water sources. In 1953 vats used to store excreta prior to application to farmland as fertilizer were centralized, replacing individual household storage vessels. They were located away from the river banks and covered to encourage anaerobic digestion. Beginning in 1964 a three-compartment fermentation tank was put into operation. In the first compartment initial decomposition and settling of parasitic ova occurs. The stagnant conditions in the second compartment promote further settling of ova. The third compartment contains digested liquid suitable for use as fertilizer. Reduction of parasitic ova in the process is generally 97-100%. Tank compartments are sized so that the first compartment holds 10 days' waste production. Biogas generators are also becoming increasingly popular; 2000 are presently in use in Shanghai County. (Cassar-FRC)
W83-03191

REMOVAL OF TRACE CHLORINATED ORGANIC COMPOUNDS BY ACTIVATED CARBON AND FIXED-FILM BACTERIA,
Stanford Univ., CA. Dept. of Environmental Engineering.
E. J. Bouwer, and P. L. McCarty.
Environmental Science and Technology, Vol 16, No 12, p 836-843, December, 1982. 8 Fig, 7 Tab, 24 Ref.

Descriptors: *Organic compounds, Water treatment, *Activated carbon, *Bacteria, Films, Microorganisms, *Wastewater treatment.

A comparison was made between the removal of chlorinated benzenes and aliphatics in a granular activated carbon (GAC) column with microbial activity versus a control column (BC) with only bacterial growth. A solution containing between 10 and 30 micrograms per liter of each chlorinated organic compound and 1.39 mg/L sodium acetate was continuously applied to both columns under aerobic conditions at a 60-min empty-bed detention time for 2 years. The GAC column initially removed all the compounds with 95-98% efficiency. Complete break-through of the chlorinated aliphatics eventually occurred, and these compounds were not biodegraded in either column. Effluent concentrations of the chlorinated benzenes in the GAC column did not change significantly during the 2 years of operation. Several chlorinated benzenes were biodegraded in both GAC and BC columns after a suitable acclimation period, and carbon-14 tracer experiments confirmed removal by a biological mechanism in both columns with complete mineralization to inorganic end products. The combination of bio-degradation and adsorption gave stability and reliability to the GAC performance. (Baker-FRC)
W83-03194

ADVANCED WASTEWATER TREATMENT BY ION EXCHANGE,
Istituto di Ricerca sulle Acque, Bari (Italy).
L. Liberti, G. Boari, and R. Passino.
Effluent and Water Treatment Journal, Vol 22, No 7, p 253-255, 256-257, July, 1982. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Ion exchange, *Nutrient removal, *Advanced wastewater treatment, *Wastewater treatment, Ammonia, Phosphate removal, Nitrogen removal, Fertilizers, Costs, Virginia, California.

This paper reports experiences in removing ammonia and phosphates from municipal effluents by ion exchange. The RIM-NUT process depends on selective uptake of ammonia from biologically treated wastewater by cationic and anionic exchange resins. Regeneration of the resins by seawater strength NaCl produces an eluate to which a Mg salt is added to precipitate > 99% pure $MgNH_4PO_4$ ($6H_2O$), a valuable slow-release fertilizer. Average nutrient removals are 85-95%. Costs for operating full-scale plants were: the $20 million plant at Tahoe Truckee Sanitation Agency, California, 67 cents-75 cents per cu m; and the $82 million plant at Upper Occoquan Sanitation Agency, Virginia, 49.2 cents per cu m. These costs do not include the return from selling fertilizer. (Cassar-FRC)
W83-03196

A METHOD FOR CALCULATING THE DIMENSIONS OF LONG SEWAGE FORCE MAINS,
Thessaloniki Univ., Salonika (Greece).
H. Hadjianghelou.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 8, p 408-412, August, 1982. 2 Fig, 1 Tab. English summary.

Descriptors: *Retention, *Design criteria, *Wastewater treatment, *Operating policies, Wastewater, Design standards, Settling basins, Sewerage, Pumping, Pumping plants.

The long force mains of sewage pumping stations create substantial operating difficulties due to long retention times when discharge is small. Operating difficulties include problems in cleaning, emptying, and filling the mains. Retention time is thus an important factor which should influence the dimensions of a design for a plant. A method is presented which leads to design solutions based on maximum allowed retention time. The strategy in this method is to build fewer, larger mains rather than numerous small ones. Example calculations are presented for the design of pumping mains for Thessaloniki in Greece. (Titus-FRC)
W83-03199

REUSE OF TREATED MUNICIPAL WASTEWATER IN THE TECHNICAL SUPPLY OF INDUSTRIAL COMPANIES IN MOSCOW (DIE WIEDERVERWENDUNG DES GEREINIGTEN KOMMUNALEN ABWASSER IN DER TECHNISCHEN WASSERVERSORGUNG DER MOSKAUER INDUSTRIEBETRIEBE),
Moscow Stadt Verwaltung fuer Wasserversorgund und Kanalization (USSR).
P. I. Galanin.
Wasserwirtschaft-Wassertechnik, Vol 32, No 8, p 264-266, 1982. 4 Fig, 1 Tab, (No English Summary).

Descriptors: *Water reuse, *Municipal wastewater, *Industrial water, *Tertiary wastewater treatment, *Filtration, Moscow, *USSR, Wastewater treatment, Packed beds, Gravel filters, Wastewater facility, Activated sludge process, Biological filters, Biological wastewater treatment, Water quality, Chlorination, Disinfection.

In the last few years, large sewer systems and wastewater facilities have been constructed in Moscow (USSR) including several hundred local industrial wastewater treatment plants. All municipal wastewater is treated in biological facilities whose efficiency is 94-95%, with additional treatmenent increasing this to 98-99%. The quality of treated municipal water used by industry is equal to that of the water types previously used. Water is prepared for specific technological processes, whereby the levels of certain substances (e.g., salts, organic compounds, biologically oxidizable organics) must be regulated. Laws forbid the use of such water by industries in which product contamination could directly harm the consumer (e.g., food and pharmaceuticals); in other industries where personnel may come into contact with the water, safety measures are required. Gravel-bed filters were first used for biological tertiary treatment at the Senelograd plant in 1965; these function by two parallel procedures: retention of suspended particles in the filter after the secondary settling basin and utilization of dissolved organic matter by activated sludge bacteria in the filter. Filtration time is 16 hr, and filter speed is 10-13 cu m/sq m per hr. After treatment, the water is disinfected by chlorination. This facility proved so successful that it was incorporated into the Novo-Kuryanovskaya activated sludge plant (treating 1 million cu m wastewater/day) with modifications: coarser granite grains of 3-10 mm were used in the filter, full drainage was installed, and filter washing with water was replaced by washing with air and water. This resulted in a doubling of performance capacity. The use of tertiary treated wastewater is about 30,000 cu m/day and is expected to increase. Most is used for cooling, watering and cleaning. (Gish-FRC)
W83-03222

PROBLEMS OF THE LOAD AT VEB ZELLSTOFF-UND PAPIERFABRIK ROSENTHAL (PROBLEME DER ABWASSERLAST IM VEB ZELLSTOFF-UND PAPIERFABRIK ROSENTHAL),
VEB Zellstoff- und Papierfabrik, Rosenthal (German D.R.).
A. Geisenheiner.
Wasserwirtschaft-Wassertechnik, Vol 32, No 8, p 268-271, 1982. 12 Fig, 3 Ref. (No English Summary).

Descriptors: *Industrial water, *Bleaching wastes, *Biological treatment, *Technology, *Wastewater treatment, *Industrial wastes, Condensation, Steam, Alkalinity, Chlorination, Pulp and paper industry, Textile industry, *German Democratic Republic.

Paper and pulp industries have traditionally consumed large quantities of water. Bleaching, sorting and other processing have required up to 1500 cubic meters of water. Bleaching, sorting and other processing have required up to 1500 cubic meters of water per ton of product in plants in Germany. Reconstruction and expansion of a plant in Rosenthal in 1977 resulted in a reduction in water requirements. The plant added new evaporation technology and water recirculation to existing mechanical and biological wastewater treatment processes. However, difficulties in effective water treatment exist. The presence of lignin in wastewater hinders biochemical decomposition. Very caustic chemicals used in the bleaching process and organic material in the condensate of the evaporation process pose further problems. Treatment of textile wastes is less successful than treatment of pulp wastewater. (Titus-FRC)
W83-03223

RETURNING THE TYNE TO LIFE,
Howl (Lee) Ltd., Tipton (England).
J. Smith.
Water Services, Vol 86, No 1038, p 375-377, August, 1982. 1 Fig.

Descriptors: *Wastewater treatment, *Pumps, *Mechanical equipment, Tyne River, Howdon, Estuaries, Water pollution control, Water treatment facilities, *United Kingdom.

The background to the Tyneside Sewerage Scheme is explained, and in particular the pumping aspects of the project are described. Real progress toward reducing pollution in the Tyne estuary began in 1958 following formation of a working party of representatives from twenty Tyneside public authorities. Nevertheless, only about 5% of the total sewage flow dumped into the river was receiving any form of treatment. The problem was further aggravated by the complex pattern of currents in the river, which prevented polluting sewage from flowing out of the estuary with each tide. Howdon sewage treatment works was built on the north bank of the Tyne and was designed to serve a future population of one million persons, and providing both preliminary and primary treatment of sewage from thee north of the Tyne and primary treatment for sewage coming from south of the Tyne. (Baker-FRC)
W83-03231

TREE OF KNOWLEDGE.
Water, No 43, p 14-15, March, 1982. 1 Fig.

Descriptors: *Wasterwater treatment, *Sludge conditioning, Cost analysis, Research priorities, *United Kingdom.

Following the reorganization of the water industry in the United Kingdom, the Standing Technical Committee on Wastewater Treatment was created to advise on the design, construction, operation, and maintenance of wastewater treatment facilities and to advise on priorities and applications of reelated research projects. The Committee placed emphasis on the identification of research and development projects which would secure the maximum value out of existing assets, and development projects which would secure the maximum value out of existing assets, The National Water Council, on behalf of the Committee, has published a volume entitled Tree of Knowledge, which reviews potential research areas in the fields of wastewater and sludge treatment. This volume presents a series of tables for each treatment stage. The tables identify the objective of the process, ask questions arising from the process stream variables and allocate priority for obtaining the answers, and examine the relationships between the given process and other stages of the processes. The review identifies a number of areas, such as the effects of bar spacing on screening efficiency and the influence of reactor loading on solids removal in humus tanks, in which it would have been assumed that sufficient information was already available. (Carroll-FRC)
W83-03234

WET OXIDATION FOR THE TREATMENT OF TOXIC INDUSTRIAL WASTES.
Water and Pollution Control, Vol 120, No 5, p 22-23, September/October, 1982.

Descriptors: *Oxidation, *Industrial wastes, *Wastewater treatment, *Wet oxidation, Design criteria, Financial aspects, Wetox, Temperature effects, Engineering, Equipment, Ontario.

The wet-oxidation system described is a result of a nine-year, million dollar development. It is a process in which liquid organic wastes are rendered harmless with minimum environmental impact. The process involves the destructive oxidation of most organic materials under water by forcing air or oxygen into the materials at elevated temperatures and pressures. The organic materials oxidize readily on contact with the oxygen, being converted mainly to carbon dioxide and releasing energy in the form of high pressure steam. This steam can be recovered for energy use with up to 80% efficiency. The products from wet oxidation are automatically and thoroughly scrubbed, since the entire reaction is carried out under water. The system provides an efficient means of recovering valuable energy from even relatively dilute waste streams. The system described is based on a horizontal agitated, multi-compartmented, cascading reactor and is able to operate at lower temperatures than other systems. Cost comparisons indicate that the Wetox process costs the same as or less than a comparable biological or incineration system. (Baker-FRC)
W83-03235

PLASTIC TANKS: PITFALLS TO AVOID,
Forbes (Kenneth) (Plastics) Ltd., Downham Market (England).
For primary bibliographic entry see Field 8G.
W83-03250

USE OF ANAEROBIC DIGESTION IN THE AGRICULTURAL AND FOOD INDUSTRIES (APPLICATION DE LA DEGESTION ANAEROBIE DANS LES INDUSTRIES AGRO-ALIMENTAIRES),
Distillerie Cooperative Agricole de la Region d'Auvernaux (Belgium).
J. P. Lescure, J. Chandesris, and P. Oger.
Industries Alimentaires Agricoles, Vol 99, No 3, p 123-130, March, 1980. 4 Fig, 3 Tab, 14 Ref. English summary.

Descriptors: *Industrial wastes, *Anaerobic conditions, *Biodegradation, *Digestion, *Food processing industry, Biological treatment, Sugars, Foods, Food-processing wastes, *Anaerobic digestion, *Wastewater treatment.

Full-scale anaerobic wastewater treatment plants have only recently been introduced in Europe, although they have been used by industry in the United States and South Africa for some time. As a result of successful experiences with this technology in sugar factories, particularly at Genappe in Belgium, the French company ERPAC is studying anaerobic plants for some other food industries. It has built a digestor for a distillery in Auvernaux. Food industries are among the greatest water polluters. The anaerobic technique is well-suited to the seasonality of the food industry, since it requires only 2 to 8 days for start-up after long periods of idleness. (Titus-FRC)
W83-03252

ON-SITE SEWAGE DISPOSAL: SITE SUITABILITY, SYSTEM SELECTION AND SOIL ABSORPTION AREA SIZING,
Pennsylvania State Univ., University Park. Coll. of Agriculture.
D. D. Fritton, D. A. Long, G. Aron, and G. W. Petersen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219725, Price codes: A13 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources Completion Report, The Pennsylvania State University, Universty Park, May 1983. 297 p, 17 Ref, 9 Apend. OWRT B-122-PA(3), 14-34-0001-0245.

Descriptors: *Home sewage disposal, *On-lot sewage disposal, *On-site sewage disposal, *Computer information delivery system, Septic tank effluent disposal, Seepage bed, Seepage trench, Elevated sand mound, Intermittent sand filter, Iodine disinfection, Rock permeability, Numerical(Relaxation) model, Percolation test, Shallow-well pump-in test, Hydraulic conductivity, *Pennsylvania, Standards, Sewage dispoal facilities, Soil water flow models, Steady state flow, Two-dimensional flow, Porous media.

Estimates of the reliability of on-site effluent disposal systems indicate that less than 50% perform satisfactorily over their design life. It is the objective of this report to describe a prototype computer information delivery system developed to improve site suitability decision making, on-site effluent disposal system selection, and soil absorption area sizing decisions. The completed computer model is written in the interactive computer language called APL. It is designed to be user friendly in the sense that little or no prior knowledge of

computers is required for its use.Users are led through a series of questions for their specific effluent disposal site. At the end of a session, the user is given a choice of system designs which are suitable. A complete copy of the computer code, its documentation, and a dictionary of terms is included. In the process of developing the model, several other studies were completed. Each individual study as initiated to provide input data or to help make decisions on alternatives that could be used. These studies included a survey of intermittent sand filter systems, a study of iodine as a disinfectant, development of a numerical model to describe flow from elevated mound systems, a literature survey on rock permeability, an experimental study of the relationship between hydraulic conductivity and the percolation rate test, and a validation study of a two-dimensional soil water flow computer model. As a result of this study, the developed prototype model is operational for research purposes. It is concluded that additional validation studies need to be made before the model can be confidently used on a routine basis. W83-03268

LAGOON ALGAE AND THE BOD TEST,
For primary bibliographic entry see Field 5A.
W83-03400

WASTEWATER TREATMENT IN RURAL AREAS. THERE DOESN'T ALWAYS HAVE TO BE A CENTRAL WASTEWATER TREATMENT FACILITY (ABWASSERREINIGUNG IM LANLICHEN RAUM. ES MUSS NICHT IMMER EINE ZENTRALKLARANLAGE SEIN).
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 8, p 417-418, August, 1982. 2 Fig. (No English Summary).

Descriptors: *Activated sludge process, *Ponds, *Rural areas, *Wastewater facilities, *Economic aspects, Costs, Construction costs, Maintenance costs, Wastewater treatment, Aeration, Large wastewater facilities, Small wastewater facilities, Water quality, Wastewater facility size.

New solutions for wastewater treatment in rural areas are required due to an expected decrease in available funds. Smaller facilities may now be considered for economic reasons, whereas they were rejected in the past as more susceptible to breakdowns, less efficient in treatment level, and requiring more maintenance than large central plants. Construction and maintenance costs are compared for facilities with activated sludge lagoons (i.e., small facilities suitable for rural areas) and activated sludge plants with continous aeration. Construction costs were lower for the facilities with lagoons: 10 lagoons, each designed for 1,000 inhabitants + or population equivalents (PE), cost about the same to construct as 1 activated sludge plant for 10,000 PE; while for ponds designed for > 1,500 inhabitants + PE, costs were lower than for activated sludge plants. For maintenance, 10 lagoons, each for 1,000 inhabitants, required 50 hr/wk, and 1 activated sludge plant for 10,000 required 38 hr/wk. Maintenance costs were about the same for five ponds designed for 2,000 clients each as for one 10,000 client activated sludge plant. For large centralized facilities, the cost of sewers must also be added, and as these cost about 400,000 DM/km for a 300-mm-diameter pipe, the economic efficiency of every facility with sewers of > 1 km should be scrutinized. One disadvantage of activated sludge lagoons is that plankton develop in the secondary treatment pond, leading to high 5-day BOD in summer. Filtered samples from the pond outlet must be used to obtain a true 5-day BOD reading. On the other hand, large facilities cause increased pollution loads in receiving streams by removing water from smaller streams to be treated and not returning it and by directing rainwater through storm drains directly to large streams, intensifying the flood wave. (Gish-FRC)
W83-03435

COSTS OF PHOSPHATE ELIMINATION IN MUNICIPAL WASTEWATER FACILITIES (KOSTEN DER PHOSPHATELIMINATION IN KOMMUNALEN KLARANLAGEN),
Hanover Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
H. Schussler.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 6, 251-257, June, 1981. 8 Fig, 5 Tab, 8 Ref. English Abstract.

Descriptors: *Municipal wastewater, Phosphorus removal, *Capital costs, *Operating costs, *Total costs, Costs, Maintenance costs, Chemical precipitation, Investment, Economic aspects, *Federal Republic of Germany, *Wastewater treatment, Storage, Personnel, Maintenance costs, Cost savings, Prices.

The German Department of the Environment conducted a survey of the capital, operating, and annual (total) costs of phosphate removal in municipal wastewater treatment facilities. The study took place in 1978/79 and covered pre-, simultaneous, and postprecipitation using Me3+ (e.g., iron chloride, aluminum chloride and sulfate), granular media (e.g., ferri-Floc), Fe2+. Savings can be made by constructing a new mechanical/biological stage with preprecipitation, since this reduces load on the biological stage by up to 40%; however, operating and supply costs are greater with precipitation. Whether simultaneous precipitation results in savings depends on wastewater composition. Precipitation can also remove other pollutants, resulting in cost savings. Despite significantly higher capital costs, annual costs of postprecipitation can be lower than those of simultaneous and preprecipitation (which are about the same), though the cheapest procedure is simultaneous precipitation with divalent iron salts (for phosphate concentrations of 20 mg/l before and 2 mg/l after treatment. Extra costs for reducing phosphate to 1 mg/l with postprecipitation were 0.01 - 0.06 DM/cu m. (Gish-FRC)
W83-03436

NEW DESIGN GUIDELINES FOR VERTICAL-CURRENT FINAL SETTLING TANKS FOR ACTIVATED SLUDGE PLANTS (NEUE BEMESSUNGS-GRUNDLAGEN FUR VERTIKAL DURCHSTROMITE NACHKLARKECKEN VON BELEBUNGSANLAGEN),
H. Resch.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 6, p 236-242, June, 1981. 9 Fig, 20 Ref. English abstract.

Descriptors: *Settling tanks, *Design criteria, *Activated sludge process, *Flocculation, *Filters, *Wastewater treatment, Advanced wastewater treatment, Dortmund tanks, Vertical current tanks, Sludge thickening, Water quality, Fluidization, Recirculation, Hydraulic properties.

Studies were undertaken at four West German activated sludge facilities with funnel-shaped final settling tanks to formulate guidelines for the design of such so-called Dortmund tanks. The tanks are a version of vertical-current tanks, which are defined as those in which the vertical component of the wastewater flow path is more than one-third of the horizontal component. Previously formulated guidelines have not taken into account the fact that in these tanks fluidization causes the formation of a filter layer of sludge flocs in vertical upflow. This floc filter is characterized by a horizontal sludge layer and an even distribution of solids in the filter volume. The studies also showed that the volume concentration constantly adopts the value of the comparison sludge volume in the tank inlet when the comparison sludge volume equals the comparison sludge volume in the floc filter, so long as the thickening zone is large enough and no backwash from it flows into the filter space. Whereas in horizontal current tanks increasing load and recirculation leads to a gradual worsening of the effluent quality, in vertical current tanks the sludge level slowly increases through an increase in filter volume without impairing effluent quality. Only when the sludge level approaches the water level does overloading occur -- the sludge overflows. When the thickening zone is used up, the filter space takes over the function of separation and storage. In the design of these tanks, the influence of tank shape can largely be ignored if surface feed is related to that tank cross-section which halves the available filter zone volume. Below this level, the filter space should always be funnel-shaped. An equation is given for the dimensioning of the thickening zone, which can be either funnel-shaped or cylindrical. (Gish-FRC)
W83-03437

ANAEROBIC ACTIVATED SLUDGE TREATMENT OF FILTRATES FROM THERMALLY CONDITIONED SLUDGES (DIE BEHANDLING VON FILTRATWASSERN THERMISCH KONDITIONIERTER SCHLAMME NACH ANAEROBEN BELEBUNSVERFAHREN),
Emschergenossenschaft, Essen (Germany, F.R.).
S. Schlegel, and K. H. Kalbskopf.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 4, p 203-208, April, 1982. 7 Fig, 5 Ref. English abstract.

Descriptors: *Anaerobic digestion, *Activated sludge process, *Wastewater treatment, *Sedimentation, *Chemical oxygen demand, Activated sludge, Wastewater facilities, Water pollution control, Federal Republic of Germany, Emscher River.

At the Emschergenossenschaft's Central Sludge Treatment Plant heat is used for conditioning the waste activated sludge. As a result of this, 2000 to 3000 cu m/day of highly polluted, odoriferous wastewaters are produced. These are treated by the anaerobic contact process. For the anaerobic treatment, three reactors were built with a total volume of 18,000 cu m. The activated sludge is retained in three gas-tight sedimentation tanks with a total volume of 1320 cu m. By the process, the COD, which averages 15,000 g/cu m is reduced by 70%. The gas yield is nearly 9000 cu m/day. Problems during the start-up phase were overcome, and the process has been very stable. The digested waters are discharged into the Emscher. The remaining pollutants are almost completely decomposed by the subsequent activated sludge processing at the Emscher Mouth Treatment Plant. (Author's abstract)
W83-03440

BIOLOGICAL WASTEWATER PURIFICATION WITH TECHNICAL OXYGEN (BIOLOGISCHE ABWASSERREINIGUNG MIT TECHN. REINEM SAUERSTOFF),
Knoll A.G., Minden (Germany, F.R.).
G. Klinzmann, and D. Stammann.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 6, p 258-262, June, 1981. 4 Fig, 1 Tab, 6 Ref. English abstract.

Descriptors: *Wastewater treatments, *Wastewater treatment facilities, *Activated sludge treatment, *Oxygen, Pilot plants, Nozzles, Odors, Odor control, Activated sludge process, Federal Republic of Germany.

After three years of construction, the fully biological purification plant at the Knoll AG works in Minden (Federal Republic of Germany) was put in operation. The plant has a daily purification capacity of up to 10 tons BOD5. In contrast to conventional procedures, the activated sludge is supplied with technically pure oxygen. BASF jet nozzles are used for gas adsorption. Because of the closed design of the activated sludge reservoirs, almost complete utilization of the oxygen is possible which almost completely eliminates annoying odors. The initial operating results of the plant agree with pilot plant results. Tests, design data, and initial operating results of the plant are presented. (Author's abstract)
W83-03443

EFFECT OF PRECIPITATION PURIFICATION ON THE BEHAVIOR OF SLUDGES DURING MECHANICAL DEWATERING (EINFLUSS DER FALLUNGSREINIGUNG AUF DAS VERHALTEN VON KLARSCHLAMMEN BEI DER MECHANISCHEN ENTWASSERUNG),
D. Gleisberg.
Gas- und Wasserfach, Wasser/Abwasser, Vol 122, No 9, p 387-391, September, 1981. 10 Fig. English abstract.

Descriptors: *Dewatering, *Sludge thickening, *Chemical precipitation, *Pilot plant studies, *Sludge drying, Drying, Digested sludge, Municipal wastewater, Iron salts, Aluminum salts, Flocculation, *Wastewater treatment, Sludge conditioning.

Four comparative test series were carried out in four municipal sewage plants to determine effects of precipitation purification on the behavior of sludge during mechanical dewatering. Three pilot plants were used: a filter bed, a filter press, and a hydrostatic bag. Sludge obtained by post-precipitation can be successfully dewatered if it is mixed with digested sludge. The amount of flocculating agent needed for conditioning digested sludge is larger when precipitation is used. In these tests, the amount of flocking agent required (g/kg of dried solid matter) was smaller than expected, indicating tha the mixed sludges are more sensitive to the conditioning agent. The resulting dried solid matter was comparable when to that obtained with conventional dewatering of digested sludges. When iron-III salt was compared to aluminum salt in simultaneous precipitation, the iron salt was most effective when the sludge was dewatered in a belt filter. This result was not confirmed with a filter press or hydrostatic bag. On the average, dewatering of sludges obtained by pre-precipitation yielded almost the same results as simultaneously precipitated sludges. Because of the smaller volume of sludge, preference is given to simultaneous precipitation. (Small-FRC)
W83-03444

AUTOMATION IN WASTEWATER TECHNOLOGY AND WATER QUALITY. PRACTICAL EXPERIENCE WITH CONTROL, REGULATION, AND AUTOMATION IN SEWER SYSTEMS, WASTEWATER TREATMENT, AND WATER QUALITY CONTROL (AUTOMATION IN DER ABWASSERTECHNIK UND GEWASSERGUTE. PRAKTISCHE ERFAHRUNGEN BEI DER STEUERUNG, REGELUNG UND AUTOMATION BEI DER ABWASSERABLEITUNG, ABWASSERBEHANDLUNG UND GEWASSERGUTEUBERWACHUNG,
Technische Univ., Munich (Germany, F.R.). Lehrstuhl und Pruefamt fuer Wassergutewirtschaft und Gesundheitsingenieurwesen.
W. Hegemann.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 10, p 438-442, October, 1981. (No English Summary).

Descriptors: *Automation, *Wastewater treatment, *Sewer systems, *Water quality control, *Wastewater facilities, Sweden, England, Process control, Computers, Measuring instruments, Mathematical models, Rainfall, Storm-overflow sewers, Sludge, Activated sludge process, Data collections, River basins, United States.

A summary is presented of the approximately 85 lectures delivered at the 1981 Workshop on Automation in Wastewater Technology held in Munich and Rome. While process control is not yet widespread, partial automatic control is more common. Principles of automation applications differ in various countries. Measurement and control of wastewater conveyance was covered by talks on a British system for the monitoring and control of rainfall overflow, consisting of a large central computer and several decentralized microprocessors, monitoring and measuring of the quality of rainfall overflow, and water volume measurement in sewers. Many lectures concerned mathematical modelling, especially in the field of activated sludge plants; models calculating the maintenance of a constant sludge concentration, the adaptation of oxygen addition to small facilities, and the maintenance of a constant oxygen concentration in step feeding were presented. Measuring instruments and parameters were discussed in works on the testing of such instruments, an underwater device for measuring respiration during the activated sludge process, and the calculation of the oxygen consumption of activated sludge by analyzing waste gas caught in the activation basin. Lectures on such topics as the possibility of regulating dissolved oxygen content, attempts to keep sludge load constant by switching the activation basin on and off, and the expansion of a mechanical facility to include activated sludge procedures and automation were grouped under the heading 'Control and Regulation in Wastewater Treatment Facilities.' The three contributions on automation described experiences with a freeze conditioning plant and a sludge-pyrolysis plant and the possibilities of the control of a sludge dewatering facility with vacuum filters. The subject of water quality monitoring was covered mainly by lectures on centralized data collection systems in river basins. (Gish-FRC)
W83-03469

5E. Ultimate Disposal Of Wastes

PHYSIOCHEMICAL PRETREATMENT OF LANDFILL LEACHATES USING COAGULATION,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 5G.
W83-03172

IDENTIFICATION AND ASSESSMENT OF EFFLUENT RESIDUALS IN TREATED LEACHATE FROM LANDFILL DISPOSAL SITES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
F. G. Pohland, J. P. Gould, R. E. Ramsey, and E. S. K. Chian.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219766. Price codes: A07 in paper copy, A01 in microfiche. Environmental Resources Center Report No. ERC 07-83, Georgia Institute of Technology, Atlanta, May 1983. 119 p, 43 Fig, 25 Tab, 182 Ref. OWRT A-088-GA(1). 14-34-0001-0111.

Descriptors: *Chlorination, *Leachate, Leachate organics, Leachate recycle, *Recycling, Toxic metals, *Toxicity, Pollutant identification, *Heavy metals, *Sludges, *Landfills, Waste disposal, *Organic compounds, Disposal sites, Aromatic compounds.

The research reported herein represents an examination of the generation, behavior and fate of specific organic compounds and functional groups in landfill test cells containing admixed heavy metal sludges. Evaluation of the impact of recycle of leachate in these systems was an object of these studies. Aromatic hydroxyl, carbohydrates, volatile acids and total carboxyl groups were the organic parameters of most use in this research. The behavior of these parameters relative to total sludge quantities and to soluble zinc, cadmium and nickel levels was assessed. The levels of heavy metal sludge in these cells was found to have a distinctly inhibitory impact on the balance between consumption and production of the various organic parameters in the two most heavily laden columns. On the other hand, the column with the least sludge behaved in a manner very similar to that of the sludge free control column suggesting a distinct capacity for the assimilation of such a sludge with minimal detrimental impact on the biological environment of the landfill. This effect was noted for all parameters studied. The heavy metal sludges demonstrated a strong capacity for binding the aromatic hydroxyl fraction of the leachate while the mobilization of toxic metals was strongly correlated with concentrations of aromatic hydroxyl in the leachate. Recycle was found to enhance the process by which moderate quantities of heavy metal sludges are assimilated by the columns with minimal inhibitory effect and to moderate the wide variations in leachate composition characteristic of ordinary landfills. The oxidation of leachate with hypochlorous acid was found to result in only moderate decreases in chemical oxygen demand even at quite high dose levels. Good disinfection was possible although a high level of chlorine demand was observed. Analysis of the chlorinated leachate by gas chromatography/mass spectrometry demonstrated the formation of complex array of potentially hazardous haloorganic compounds by chlorination of the leachate organic compounds. These findings predicate against chlorination as a means of treating leachates.
W83-03272

UNDISTURBED CORE METHOD FOR DETERMINING AND EVALUATING THE HYDRAULIC CONDUCTIVITY OF UNSATURATED SEDIMENTS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 2G.
W83-03319

CHEMICAL EFFECTS OF SELECTED TRACE-METALS FROM SANITARY LANDFILL LEACHATES ON GROUNDWATER QUALITY,
Kansas Water Resources Research Inst., Manhattan.
E. E. Angino, and E. C. Vogl.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222380, Price codes: A04 in paper copy, A01 in microfiche. Contribution Number 221, Dec 1981. 61 p, 8 Fig, 9 Tab, 39 Ref, 3 Append. OWRT A-094-KAN(1), 14-34-0001-9018.

Descriptors: Groundwater, Supersaturation, Percolation, Chemicals, Solid wastes, Municipal wastes geohydrology, Aerobic conditions, *Kansas, *Path of pollutants, *Trace metals, Lawrence, Water pollution sources, Kansas River, *Sanitary landfills, Hazards, *Leachates, Disposal sites.

Nationwide use of sanitary landfills as disposal sites for municipal wastes has increased concern for their capacity to contaminate local groundwater systems. This matter stems from the fact that potentially dangerous leachage ultimately forms in and permeates regions adjacent to a landfill. Under favorable geohydrologic conditions, this solution may enter nearby aquifers used for drinking water. Two sanitary landfills, both in Lawrence, Kansas, were investigated as to the actual or potential impact of selected trace-metals (Cu,Co,Cr,Ni,Pb,Cd,Mn,Fe, and Zn) accumulated in these leachates on local ground water quality. In addition, pH, specific conductance, temperature, and dissolved oxygen were used to further identify potential hazards at these two landfills. One landfill, southwest of Lawrence, is in an upland area and has been out of use since 1969. The effluent from this landfill has general chemical characteristics and trace-metal content indicating an aerobic environment. There appears to be no contamination by this landfill of surrounding local ground water. The other landfill, north of Lawrence, is in the Kansas River floodplain and has been in use since 1970. The leachate generated typically contained less dissolved oxygen, more dissolved solids, more soluble trace-metals, and is more acidic than leachate derived from the upland landfill. At the floodplain landfill, an anaerobic-aerobic environment exists immediately surrounding the area of buried refuse. There is no evidence based on chemical constituents investigated that the floodplain landfill poses any threat to local ground water quality or to the water quality of the adjacent Kansas River.
W83-03340

PRIORITY POLLUTANTS IN MUNICIPAL SEWAGE SLUDGE, PART II,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
L. M. Naylor, and R. C. Loehr.
BioCycle, Vol 23, No 6, p 37-42, November/December, 1982. 5 Tab, 28 Ref.

Descriptors: *Sludge, *Land disposal, *Public health, Human diseases, Fate of pollutants, Pesticides, Toxicity, Water pollution sources, Food chain.

A perspective on public health risks and the absence thereof from land application of sludge is presented based on data from sludges produced in 20 United States cities. Data is presented which shows that organic priority pollutants have acute toxicities similar to those of pesticides and household chemicals. Application rates of priority pollutants to sludge amended soils are substantially less than typical pesticide application rates to agricultural soils. While insufficient information is currently available on the fate and transformation of

organic priority pollutants in soils and on the uptake and translocation of such chemicals in crops to assess food chain risk, scenarios were developed which provide a perspective on potential health risks associated with the direct ingestion of contaminated soil and crops bearing the residue of such soil and sludge. These scenarios indicate that, except possibly where sludge is consumed directly in very large amounts, consumption of contaminated soils or crops is not likely to result in the ingestion of amounts of organic priority pollutants exceeding the acceptable daily dose. (Baker-FRC)
W83-03406

DEVELOPMENTS, RECOMMENDATIONS AND APPLICATIONS OF TESTS FOR EVALUATING THE CHEMICAL STABILITY OF HIGH-LEVEL RADIOACTIVE SOLID WASTE FORMS,
North Carolina State Univ. at Raleigh. School of Engineering.
For primary bibliographic entry see Field 5B.
W83-03427

CHEMICAL SPECIATION OF LEACHATES FROM WASTE DISPOSAL SITES,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W83-03432

5F. Water Treatment and Quality Alteration

THE EFFICACY OF REMOVAL OF HEAVY METALS FROM WATER BY CALCITE,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
S. D. Faust, and C. M. Schultz.
Journal of Environmental Science and Health, Part A, Environmental Science and Engineering, Vol 18, No 1, p 95-102, 1983. 2 Fig, 1 Tab, 9 Ref.

Descriptors: Metals, *Calcite, Adsorption, *Heavy metals, Calcium carbonate, Cadmium, Copper, Lead, Zinc, *Water treatment.

A commercial grade of calcite adsorbed Cd, Cu, Pb, and Zn from water in batch and column tests. No attempt was made to control pH, which was 7.0-8.4 in the columns and 8.0-9.2 in the batch systems. The calcite adsorbed or precipitated about 80% of the Pb and 35-45% of the other three metals. Adsorption of metals (micrograms per g) in the batch systems was 150 for Pb and 35-40 for the other metals; in the colums, 83 for Pb and 16-33 for the other metals. (Cassar-FRC)
W83-03157

MOLECULAR SIZE DETERMINATION OF CHLOROFORM PRECURSORS,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5A.
W83-03187

WATER MANAGEMENT FOR PACKAGED BOILER SYSTEMS,
G. S. Solt.
Effluent and Water Treatment Journal, Vol 22, No 7, p 259, 261, 263, 265, July, 1982. 1 Fig, 1 Tab.

Descriptors: *Boiler water, *Water quality, *Water conditioning, Water treatment, Blowdown, Ion exchange, Water softening, Reverse osmosis, Demineralization, Corrosion control, Scaling, Oxygen removal, Steam.

Factory-built packaged boilers tolerate a small margin of error in operation because of intensive use of the heat transfer surface. Total dissolved solids, hardness, silica, and suspended solids must be controlled within acceptable limits. Management methods are available for this purpose. First, design and operation should aim for the smallest possible volume of blowdown that is economical. Several processes are available for treating makeup water: lime softening, reverse osmosis, and modifications of ion exchange processes (base exchange, dealkalization-base exchange, sodium-hydrogen blend, and demineralization). Choice of the most suitable treatment depends on the raw water quality, the costs of energy and chemicals, the amount of condensate return, boiler water limits, and the substances added by conditioning chemicals. Use of conditioning chemicals depends on raw water quality and the degree of oxygen removal, scale prevention, corrosion inhibition, and foam reduction required. A sensible water management program must be based on the needs of the individual system as a whole. (Cassar-FRC)
W83-03205

GAMEKEEPER, POACHER--THE WELSH WA APPROACH,
D. G. Walker.
Effluent and Water Treatment Journal, Vol 22, No 7, p 268-269, 271-273, July, 1982. 3 Fig, 10 Ref.

Descriptors: *Monitoring, Welsh Water Authority, Water quality control, Pollutant identification, Standards, Legal aspects, *Wales.

Regional water authorities, established in the United Kingdom in 1974, were charged with conflicting duties: to maintain water services and to exercise a regulatory function over these services. The Welsh Water Authority organized a three-team water quality audit group, directly responsible to the director of scientific services. The North, Southeast, and Southwest each have a five-member audit team responsible for an impartial independent assessment of potable water quality, treatment plant performance, and surface (tidal and fresh) water quality. Each audit team monitors 2 or 3 divisions. Although each division has first claim to investigate water quality problems, the audit team may initiate investigations in case of conflict. Audit samples are not analyzed by divisional personnel. Flexibility is important in scheduling work so that routine surveillance may be dropped in favor of higher priority pollution investigations, if necessary. At present the audit teams are biased toward the potable water supply. Three years' experience has shown that the audit teams' reports carry considerable weight. Handling of water quality problems can be expedited through the audit teams' direct link with the director. The competitive spirit between audit teams and divisions has stimulated both parties to make best use of their resources. (Cassar-FRC)
W83-03219

HOW PULSATORS AND SUPERPULSATORS CAN IMPROVE THE WATER TREATMENT PROCESS,
Societe Degremont, Rueil-Malmaison (France).
Z. Mardirossian.
Water and Pollution Control, Vol 120, No 5, p 20, September, 1982. 2 Fig.

Descriptors: *Water treatment, *Pulsators, *Equipment, Water purification, Drinking water, Potable water, Design criteria, Engineering.

The Pulsator and the Super-Pulsator Clarifiers are high-rate sludge blanket type units specifically designed to combine coagulation, flocculation and sedimentation in one unit. The Pulsator Clarifier requires extremely limited maintenance, offers a reduction in the percentage of suspended and colloidal matter in the raw water which is impossible to achieve by other methods, has high sludge concentrations and low water losses, has outstanding operational simplicity and flexibility, consumes small amounts of energy, and offers uniform distribution of raw water and collection of clarified water over the whole area of the tank. Thus the system combines the advantages of an expanding sludge blanket with the technology utilizing inclined parallel plates within the sludge blanket. Flat sloping plates equipped with defectors are actually located within the sludge blanket to further aid sludge recirculation and increase concentration. (Baker-FRC)
W83-03220

WATER PLANT GROWS BIGGER, CUTS ELECTRIC BILL.
Water/Engineering and Management, Vol 129, No 13, p 29-30, December, 1982.

Descriptors: *Water treatment facilities, *Mixing, *Mechanical equipment, Water treatment, Cost analysis, Chemical treatment, Design criteria, *Arizona, Phoenix, Mesa.

The Val Vista Water Treatment Plant, which is jointly owned by the cities of Phoenix and Mesa, Arizona, has undergone changes to expand its capacity. One of the principal components of its upgrading was the installation of an in-line motionless mixer. The mixer, designed by Komax Systems, Incorporated, of Long Beach, serves to dose aluminum sulfate and chlorine into raw water after clarification during the water treatment process. It consists of a series of interlocking left-and right-handed mixing elements which, under turbulent flow, produce elliptical vortices rotating in opposite directions on either side of each element. The mixer produces a back-mixing effect that disperses the chemicals, which are added through several spargers, evenly and rapidly. The 20-ft-long unit is fabricated of carbon steel and is bolted to the concrete channel. After mixing, the chemicals are settled out by flocculation, and the water is sent to holding reservoirs or distribution systems. Cost analyses based on several months of operation show that the new mixer has significantly reduced costs. The Komax unit requires no additional energy to operate and virtually no maintenance, since it has no moving parts. The new unit also produces no noise, which greatly improves the work environment. (Geiger-FRC)
W83-03226

MOTHER NATURE AS SLUDGE THICKENER,
Onondaga County Metropolitan Water Board, Syracuse, NY.
C. Canfield, and R. L. Sutphen.
Water/Engineering and Management, Vol 129, No 13, p 22-24, December, 1982.

Descriptors: *Water treatment, *Filtration, *Sludge thickening, *Freeze-thaw tests, *Alum sludge, Economic aspects, Dewatering, Coagulation, Freezing, Pilot plants, Separation techniques, *New York.

The Onondaga County Metropolitan Water Board has significantly upgraded its water treatment plant at the Lake Ontario Filtration Plant by combining an unconventional backwash system that relies on natural freezing and thawing cycles to dewater alum sludge with an innovative filtration system using water from Lake Ontario. The project was undertaken after the modification of a discharge permit which required reduction of suspended solids discharged into Lake Ontario. The conversion to high-rate direct filtration would allow an economical expansion of the plant without further construction. A testing process for direct filtration was started, along with trials for a method of handling process wastes from the backwash. To handle solids separation, the two existing detention lagoons were modified to hold consecutive backwashes of the filters at a rate of 22 mgd. A sludge pumping system built by the Crisafulli Pump Company was selected to handle sludge removal. Freeze thaw tests were conducted for studying sludge separation. Regardless of the pumped sludge's concentration, it separated into sludge and clear supernatant upon freezing. Two additional freeze beds were constructed to handle the anticipated sludge quantities. During 1981, about 75,000 cu ft of sludge were successfully removed from the lagoons and placed in the freezing/thawing beds. The permanent facilities have reduced personnel, time, and cost, and were installed at a capital cost of less than $300,000. (Geiger-FRC)
W83-03227

PRECHLORINATION AND TRIHALOMETHANE FORMATION AT WATER TREATMENT,
Ontario Ministry of the Environment, Toronto.
A. H. Vajdic.
Water and Pollution Control, Vol 120, No 5, p 29-31, 45, September/October, 1982. 1 Tab, 12 Ref.

Descriptors: *Drinking water, *Chlorination, *Trihalomethanes, Disinfection, *Water treatment, Purification, Potable water, Canada, Toronto, *Ontario, Metropolitan water management, Water management, Bacteria, Coliforms.

The effect of removing prechlorination steps from the treatment of drinking water with respect to both the microbiological quality of the water produced and the trihalomethane content of that water was examined. Three Metropolitan Toronto water plants were included in the study. Measurements were made in three phases: first, while pre-chlorination was being conducted as usual; second, while pre-chlorination had been discontinued; and third, when prechlorination procedures were once again established. The total bacterial count in the filtered water was higher during the phase where pre-chlorination was not carried out. Indicator bacteria such as coliforms, fecal coliforms and fluorescent Pseudomonas species were reaching the final chlorination stage of treatment during this period of no prechlorination. This would necessitate a very stringent control at the final chlorination stage. The THM production appeared to be lower on the average in the absence of pre-chlorination, but the omission of the pre-chlorination stage should only be considered where properly designed chlorine contact facilities are available to ensure adequate retention times during final disinfection. (Baker-FRC)
W83-03228

THE ZURICH WATER SUPPLY SYSTEM,
M. Schalekamp.
Water Services, Vol 86, No 1038, p 366-370, August, 1982. 2 Fig.

Descriptors: *Water supply, *Drinking water, *Groundwater, *Lakes, Wells, Spring water, Zurich, *Switzerland, Water resources development, Potable water.

Zurich obtains its drinking water from three sources, the Lake of Zurich, groundwater, and springwater. The heaviest reliance is on lakewater; two plants have been built to extract and treat it. Groundwater is extracted at Hardhof at a rate of up to 150,000 m/d by means of four horizontal filter wells. Spring water comes from 123 springs in the Sihl and Lorze valleys, contributing a total daily production of 20,000-30,000 cubic meters. The water passes through the following treatment stages: flocculation, rapid filtration, ozonation, activated carbon filtration, slow filtration, neutralization and disinfection. A computer-based operation has been devised to simplify and improve the operational reliability of the plant. (Baker-FRC)
W83-03229

FIT TO DRINK,
Yorkshire Water Authority (England).
W. M. Jollans, and T. Zabel.
Water, No 43, p 7-9, March, 1982.

Descriptors: *Water treatment, *Municipal water, Technology, Lead, Nitrate, Organic compounds, Water quality management, Automation, *United Kingdom.

The British Standing Technical Committee on Water Treatment has produced a final report entitled 'Fit to Drink'. This report deals primarily with the progress of research with respect to health related aspects of water supplies, focussing on the operational side of water treatment practice and, in particular, on the instrumentation, control, and automation of water treatment processes. Problems related to lead in drinking water and remedial measures for addressing these problems are discussed. Increasing nitrate concentrations and methods of nitrate removal are examined. Problems relating to organics and micropollutants in water supplies are reviewed. The need to improve the treatment of small public water supplies is discussed. Differences in water treatment practices on the continent and in the United Kingdom are identified. Problems which can arise from large scale water transfers and other changes in water source are described and methods of minimizing risks are outlined. Advantages and disadvantages of instrumentation, control, and automation are discussed. (Carroll-FRC)
W83-03236

WATER AND SEWER SYSTEM MODELLING USING A MICRO-COMPUTER SYSTEM,
Surrey District, Vancouver (British Columbia).
K.-B. Lee.
Water and Pollution Control, Vol 120, No 4, p 10, 43, July/August, 1982.

Descriptors: *Model studies, *Computers, *Sewer systems, Sewers, Wastewater disposal, Flows, Mathematical equations, Water distribution, *British Columbia, Vancouver.

Surrey is a large, rapidly growing municipality located on the outskirts of Vancouver. As a result of rapid urbanization, an enormous demand was placed on the municipal servicing system. To solve various problems to Surrey Engineering Department decided to develop computer models of servicing systems, especially water and sanitary sewer systems. A cost-benefit systems analysis was performed to answer two major questions: which microcomputer among the many available was best to have, and what computer programs could be implemented on microcomputers and meet the modelling requirements. The distribution system under study consists of 950 km of water mains. Due to the topographic situation the water system is currently divided into 22 zones by a number of isolating and pressure reducing valves. The computer as designed provides the area engineers with residual pressures on water distribution networks for various water demand and system pressure conditions. Also, it provides the department with capacity of sewers, estimated peak and average sewage flows, and corresponding flow velocity and depth. (Baker-FRC)
W83-03243

WINTER OF FROSTS, FLOODS AND BURSTS.
Water, No 43, p 2-5, March, 1982.

Descriptors: *Frost, *Floods, Weather, Water management, Water mains, Water conveyance, Water demand, Water delivery, *United Kingdom.

The winter of 1981-1982 brought severe weather, which presented a variety of problems for water authorities throughout the United Kingdom. A very high tide, combined with a force 10 gale, caused a tidal surge and wave action which breached sea defenses and caused flooding in several areas early in December, 1981. This was followed by the worst freeze-up in living memory, with record low temperatures causing a wave of burst water mains throughout the country. In many water authorities, there were ten times as many bursts per day as experienced in previous years. In addition, thousands of private homes reported burst pipes. These leaks, combined with the effects of many consumers leaving taps running at night to prevent freezing of pipes, placed considerable strain on water reserves. In several locales, water demand was at levels normally only experienced in summer months. Subsequent thawing in early January resulted in flooding, with many areas experiencing 10 year flood levels. (Carroll-FRC)
W83-03244

VALVES, PENSTOCKS AND ACTUATORS: RELIABLE CONTROL OF WATER SYSTEMS,
H. E. Jordens.
Water Services, Vol 86, No 1032, p 63-64, February, 1982.

Descriptors: *Water management, *Automation, Water treatment facilities, Water conveyance, Water quality management, Metropolitan water management, *United Kingdom.

Several water authorities in the United Kingdom are using valves and Westinghouse Data Acquisition and Control (Wesdac) equipment and softwater produced by Westcode Systems as integral components of water supply monitoring and control systems. These components include multiport spool valves, the Derion blowing seal, and distributed processing systems. The multiport spool valves can be used as the flow selection mechanism in an on-line effluent quality monitoring system. The blowing seal, which is one of the range of rotary vane valves manufactured by Westcode Systems, is used by several water authorities to control the flow of lime and soda ash between a storage silo and a positive or negative pressure pneumatic conveying system. This valve can be fitted with a variable speed motor in order for it to act as a metering unit. The distributed processing systems in the Wesdac range of supervisory control equipment and software comprise a single or dual mini-computer based control center connected to a number of microprocessor based remote terminal units by a serial communication circuit. The control center provides overall strategic plant control, historic data storage and trend displays for long term management information, and such other functions as statistical analysis and modelling. The contral operator can use a visual display unit and associated keyboard to manually control the status or performance of individual items or groups of operations. Potential areas for expansion of automated control facilities are under active study. (Carroll-FRC)
W83-03245

WATER SUPPLY FOR THE LIZARD.
Water Services, Vol 86, No 1038, p 393-394, August, 1982. 1 Fig.

Descriptors: *Water supply, *Water treatment facilities, Wendron Water Works, Rivers, Water quality, Water resources development, Intakes, *United Kingdom.

A new Wendron Water Treatment Works supplying the Lizard Peninsular area was officially opened in June of 1982, with almost four times the capacity of the works it replaced. A new river intake was provided near the site of the original, with the advantage of coping with flows supplemented by pipeline from the Stithians reservoir. Several modern engineering concepts were embodied in the scheme, including Superpulsator clarification for a high standard of treatment, computer control of the entire system, and use of the latest type of variable speed pumps for maximum energy conservation. The new intake is just below the confluence of the River Cober and Releath Stream. A crump weir has been provided to give adequate means of measuring abstraction and regulation flows. The treatment system incorporates inlet mixing followed by chemical dosing using aluminum sulfate as the main coagulant. A coagulant aid, lime for pH correction and provision for powdered carbon when taste and odor problems occur are provided. The whole works can be controlled and monitored automatically. (Baker-FRC)
W83-03246

THE ROLE OF CATIONIC SURFACTANTS IN THE RENOVATION OF WATER,
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
D. W. Weeter, and K. L. Roberts.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219790. Water Resources Research Center Research Report No 87, Univ. of Tennessee, Knoxville, June 1983. 225 p, 17 Tabs, 92 Fig, 77 Ref. OWRT B-045-Tenn(1), 14-34-9096.

Descriptors: *Cationic surfactants, Pollutants, Potable water, Water renovation, *Coagulants, Floc, *Dewatering, Disinfection, Clay, Sludge, *Surfactants, *Wastewater treatment, Water treatment, Jar test procedures, Adsorption.

The objectives of this research project are, as quoted from the proposal: (1) to examine the kinetics and effectiveness of disinfection with cationic surfactants, (2) to characterize the use of cationic surfactants as coagulants and coagulant aids in raw water treatment, (3) to describe the ability of cationic surfactants to remove trihalomethane precursors (humic and fulvic compounds) from water, (4) to determine the ability of surfactant-induced floc to adsorb nonpolar organic compounds from water and, (5) to examine the dewatering charac-

teristics of surfactant-induced floc particles. Jar test procedures were utilized to obtain most results. It was demonstrated that cationic surfactants are extremely effective bactercides against two common organisms, one of them pathogenic. It was demonstrated that cationic surfactants are extremely effective coagulants of particulate matter (clay) and color. It was demonstrated that surfactant-induced clay floc does adsorb organics but that the process is severely limited. It was demonstrated that cationic surfactant-induced floc particles are highly hydrophobic and have specific resistances several orders of magnitude lower than those of alum floc particles produced under similar conditions. Most of the results have exceptional significance to the water treatment industry. The cationic surfactant treatment process removes particulate matter and soluble molecules such as humic acid and lignin; the sludge produced is highly hydrophobic, which means that it is easy to dewater and settles to a very small volume. Any organisms in suspension are inactivated.
W83-03275

REMOVAL OF NITRATE, SULFATE AND HARDNESS FROM GROUNDWATER BY ION EXCHANGE,
Iowa State Water Resources Research Inst., Ames.
J. L. Musterman, D. W. Swailes, T. J. Laford, and D. A. Bergo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220335, Price codes: A06 in paper copy, A01 in microfiche. Completion Report No 112, February 1983. 111 p, 30 Fig, 13 Tab, 46 Ref. OWRT A-075-IA(1), 14-34-0001-0117.

Descriptors: *Nitrates, *Sulfates, *Hardness, Mathematical models, Design criteria, Drinking water, *Ion exchange, *Water treatment, Resins, Anion resins, Groundwater.

Removal of nitrate, sulfate and hardness with strong base resins is possible. The purpose of this study was to determine the effects of nitrate and sulfate loading on regeneration efficiency of strong base anion exchange resins and to develop design criteria for nitrate and sulfate removal. An empirical model to predict regeneration requirements for strong base anion exchange resins for nitrate removal was developed and verified. Extensive laboratory test using various exchange resins were used to verify the model. A second model was developed to predict the length of time for exhaustion of the resin as a function of loading. Several anion resins were evaluated for nitrate removal. No significant difference in the regeneration efficiencies between resins was observed.
W83-03290

THE FATE OF ANTIFOULANT ORGANOTIN COMPOUNDS IN WATER SYSTEMS,
District of Columbia Univ., Washington. Coll. of Physical Science, Engineering, and Technology.
For primary bibliographic entry see Field 5B.
W83-03315

A NOVEL BACTERICIDAL AGENT FOR TREATMENT OF WATER,
Auburn Univ., AL. Dept. of Chemistry.
S. D. Worley, W. B. Wheatley, H. H. Kohl, H. D. Burkett, and J. H. Faison.
In: Proceedings 4th Conference on Water Chlorination: Environmental Impact and Health Effects, Pacific Grove, CA, Oct 18-23, 1981. Vol 4, Book 2, Ann Arbor Science Publishers, 1982. p 1105-1113, 2 Fig, 1 Tab, 10 Ref. Jolley, R. L., et al., ed. OWRT A-072-ALA(4), 14-34-0001-9001.

Descriptors: Chemical reactions, Treatment, *Water purification, *Water treatment, Chlorine, *Disinfection, Water quality, *Chlorination, Bactericides, Wastewater treatment.

Although chlorination remains the most used method for disinfection of public water supplies, several factors detract from the desirability of chlorine gas as a bactericidal agent. The chloramine agent 3-chloro-4, 4-dimethyl-2-oxazolidinone (Agent I) has been tested as a bactericide for the disinfection of water. It kills E. coli in water in a concentration range (equivalent 5 mg/L), which is comparable to that used in standard chlorination in treatment plants. Other bacteria are also destroyed by Agent I, although generally requiring higher concentration levels. In a laboratory-scale water treatment plant, Agent I produced bacteria-free water when used in conjunction with a 15-ft sand filter. Preliminary toxicity data indicate that Agent I and its decomposition products are relatively nontoxic. Agent I is a stable solid and, as such, could not lead to catastrophic accidents in treatment plants or during public transportation. Furthermore, in water solution, Agent I releases chlorine only on demand and thus remains stable in solution for extended periods. Given that chloramines do not tend to produce toxic haloforms in water as does chlorine gas, and the other advantages of Agent I cited above, we believe that Agent I represents a realistic alternative to chlorine gas for use in water disinfection if it can be produced at a reasonable cost.
W83-03337

UV-OZONE PROCESS FOR THE CONCURRENT DECOMPOSITION OF HALOGENATED ALKANES AND THE DISINFECTION OF WATER,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
C. P. C. Poon, and B. M. Vittimberga.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222364, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center Technical Report No 10, December 1982. 22 p, 5 Fig, 5 Tab, 10 Ref. OWRT A-076-RI(1), 14-34-0001-1142.

Descriptors: *Ultraviolet radiation, *Ozonation, Kinetics, Optimization, Coliforms, *Disinfection, *Water treatment.

The use of ozone in combination with ultraviolet radiation is studied as a treatment process for the removal of chloroform and bromodichloromethane from drinking water. A first order removal kinetic is found. Treatment with UV radiation alone with 10.6 w/l power input and 15,800 uw sqcm intensity is found to be ineffective for CH3C13 removal. In a mixture of the two compounds, each breaks down independently at its own rate by removing both CHC13 and CHBrC12 individually or in combination. Air purging experiments using a flow rate identical to the ozone gas flow treatment is more effective than the combination of the individual removals by ozone and by UV radiation. The result of this study also shows that with 10.6 w/l power input of UV radiation and 6.4 mg ozone/min dosing rate, a removal of coliform (100%) is consistently obtained with 30-minute exposure.
W83-03338

CAUSES OF LOCALIZED COPPER CORROSION IN DRINKING WATER SUPPLIES,
Arkansas Univ. at Little Rock. Dept. of Electronics and Instrumentation.
R. A. Sims, and R. W. Raible.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222448, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 94, Univ. of Arkansas, Fayetteville, May 1983. 11 p, 14 Ref. OWWR A-043-ARK(1), 14-34-0001-8004.

Descriptors: *Copper, *Corrosion, *Potable water, *Taste, Corrosion control, Water quality, Impaired water quality, *Arkansas, Lake DeGray, Arkadelphia.

Excessive amounts of copper have been observed in drinking water at certain installations on Lake DeGray and at isolated locations in the Arkadelphia area of Arkansas. A study of these installations was conducted to determine the source of the copper contamination. The supply water was very low in copper and therefore dissolution of the copper plumbing caused by low water pH and long residence times was determined to be the most probable source.
W83-03346

OPTIMIZATION AND DYNAMIC CONTROL OF THE COAGULATION PROCESS IN WATER TREATMENT,
New Hampshire Univ., Durham. Water Resources Research Center.
P. J. Ossenbruggen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224220, Price codes: A04 in paper copy, A01 in microfiche. Research Report No 40, May 1983. 58 p, 16 Fig, 8 Tab, 31 Ref, 1 Append. OWRT B-005-NH(4), 14-34-0001-9122.

Descriptors: *Optimization, Dynamic, *Coagulation, *Water treatment, *Color, *Turbidity, Temperature, Mechanical mixing, Time series analysis, Alum treatment.

Water quality variables, color, turbidity, and temperature, show pronounced variations with time. These dynamic characteristics have a dramatic impact upon the treatment of these waters for human consumption. The purpose of this work is to identify the factors that can be introduced into a strategy for optimally removing color and turbidity from raw waters. A series of jar tests on color-turbidity samples and natural water samples show that color is the critical factor in determining the critical chemical dose for maximum color and turbidity removal. The effects of temperature and mechanical mixing were also investigated and reported. With the use of time series methods, a dynamic control strategy for treating surface waters with alum was developed. These studies show the strategy is economical and effective in reducing the risk of underdosing.
W83-03373

EFFECT OF IRON AS A TRACE IMPURITY ON THE WATER SOFTENING PROCESS,
Iowa State Univ., Ames. Engineering Research Inst.
R. W. Peters, and J. D. Stevens.
AIChE Symposium Series, Vol 78, No 215, p 46-67, 1982. 14 Fig, 8 Tab, 27 Ref.

Descriptors: Water quality, *Water softening, *Iron, Kinetics, Chemical reactions, Crystallization, *Water treatment.

Experimental studies were performed to determine the precipitation kinetics of the combined calcium carbonate-magnesium hydroxide system, both in the pure system and in the presence of trace quantities of iron. A brief review of the water chemistry, steady state crystallization theory, and effect of impurities is presented. The kinetics of simultaneous calcium carbonate and magnesium hydroxide precipitation are sensitive function of pH. The growth rate, nucleation rate, and kinetic order were measured for various alkalinity distributions and various iron concentrations. Iron can be removed through the use of the lime/soda-ash water softening process forming insoluble iron precipitates, which are amorphous in nature. The removal of the iron is strongly pH dependent. The iron, acting as an impurity to the system, markedly affects the amount of wall deposition. The iron caused a slight inhibition of the growth rate, but greatly enhanced the nucleation rate. The crystal growth rate of the calcium carbonate-magnesium hydroxide precipitate decreases with increasing iron concentration. The growth inhibition contributes to the formation of a bundle crystal structure for the aragonite precipitate.(Baker-FRC)
W83-03411

TRIHALOMETHANE REMOVAL AND FORMATION MECHANISM IN WATER,
Howard Univ., Washington, DC. Dept. of Chemical Engineering.
R. C. Chawla, M. M. Varma, A. Balram, M. M. Murali, and P. Natarajan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224410, Price codes: A04 in paper copy, A01 in microfiche. District of Columbia Water Resources Research Center Publication No 48, Univ. of the District of Columbia, May 1983. 54 p, 21 Fig, 2 Tab, 12 Ref. 3 Append. OWRT A-021-DC(1), 14-34-0001-2109.

Descriptors: Trihalomethane removal, Trihalomethane adsorption, *Water treatment, Trihalomethanes, Gas chromatography, *Activated carbon, Batch removal, Continous removal, Adsorption.

Trihalomethane (THM) formation kinetics and removal by Granulated and Activated Carbon (GAC) were studied. The formation studies showed that about 90% of the total trihalomethanes (TTHM) formed is chloroform and the other 10% included the remaining three (THM's, namely CHCl sub 2 Br, ChBr sub 2 Cl and ChBr sub 3. The THM formation rate decreases with time and the formation potential of TTHM increases nonlinearly with the chlorine dosage. Over a wide range of solids (precursor) concentrations (15-150 mg/l), the mechanism of THM formation appears to remain unchanged. Similar results were also observed for chlorine concentration over a range of 2-15 mg/l. A simple kinetic model was applied to the data and a reaction order of 0.3 was calculated for chlorine concentration in the THM formation rate. THM removal was studied using both batch and continuous methods, Freundlich adsorption Isotherms fit the batch data very well. 86-97% removal of THM was observed over a period of 1-8 days. In continous method, the % removal dropped significantly when carbon dose was reduced. The removal efficiences were generally much lower for continuous method than for batch method.
W83-03430

MONITORING FLOCCULATION IN WATER TREATMENT USING A COMPUTER-CONTROLLED PHYSICAL MODEL (UBERWACHUNG DER WASSERAUFBEREITUNG MIT HILFE EINES RECHNERGESTEUERTEN PHYSIKALISCHEN MODELLS),
DECHEMA, Frankfurt am Main (Germany, F.R.).
K. Ahrens, and V. G. Gunderlach.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 123, No 3, p 131-138, March, 1982. 9 Fig, 9 Ref. English abstract.

Descriptors: *Flocculation, *Drinking water, Model studies, *Optimization, *Computer models, Computers, *Water treatment, Mathematical models, *Federal Republic of Germany.

Flocculation is an important step in the conversion of polluted surface waters into drinking water. When raw water quality and operating costs are constant, the performance of a flocculation plant depends not only on the design parameters but also on the process variables such as flocculant concentration. Process variables for a particular sludge contact process can be derived from a microcomputer controlled physical model, which is of similar design and operates in parallel to the large scale plant. The automatic optimization can be selected to tend toward either the technical optimum (maximum water quality) or the economic optimum. Variation of the flocculant to flocculation-aid ratio is suggested for further cost savings. This suggestion is based on a mathematical model, the parameters of which have been experimentally determined for a simple flocculation system (drinking water/china clay). (Author's abstract)
W83-03439

PROMISING EXPERIMENTS ON LEAK LOCATION BY MEANS OF CORRELATION (AUSSICHTSREICHE VERSUCHE ZUR LECKORTUNG MITTELS KORRELATION),
Stuttgart Univ. (Germany, F.R.).
C. Laske, D. Weimer, and H. V. Fuchs.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 3, p 112-115, March, 1981. 6 Fig, 2 Ref. English abstract.

Descriptors: *Water conveyance, *Networks, *Leakage, *Correlation analysis, *Water loss, *Leak location, Leak detection, Mathematical analysis, Measuring instruments, Mathematical equations, Water distribution, Water mains, Conveyance structures, Pipes.

The Stuttgart Technical Works (STW) and the Fraunhofer Institute for Construction Physics (FICP) have conducted a project to locate leaks in a water conveyance network using correlation analysis since 1979. As in the conventional method of locating leaks, the correlation technique utilizes sound. However, instead of relying on the intensity of the sound produced by the leak, the correlation method uses a difference in transmission time of soundwaves at two measuring stations, one on either side of the leak. In addition, the sound level of the leak noise can lie beneath that of ambient noise, since the latter is taken into account in the correlation equation; and the recognition of a leak noise by a characteristic sound spectrum is unimportant, so that the subjective experience of a 'listener' can be replaced by a series of objective indications. Two-point cross correlation is used to detect a leak, which signals its presence by producing a marked maximum transmission time difference visible on an oscillograph attached to the correlation device. Both the equation for the calculation of the correlation coefficient and an equation to calculate the distance of the leak from the measuring station are given. STW has designed a mobile measuring station, a van equipped with devices for combined leak analysis and location, a universal recording apparatus to plot pressure and volume, an inductive flow volume-measuring device and electronic network pressure gage with digital display, space-saving hydraulic equipment, and an independent electricity supply. The STW/FICP tested 400 km of water conveyance network in under two years and uncovered annual losses of 1.8 million cu m. Of the leaks, 17% (30% of volume lost) were in distribution pipes, 37% (11%) in fittings (e.g., hydrants), and 46% (59%) in connecting pipes. (Gish-FRC)
W83-03445

TOPICAL QUESTIONS ON CENTRAL CONTROL AND MONITORING FOR WATER SUPPLIES (AKTUELLE FRAGEN BEI ZENTRALER STEUERUNG UND UBERWACHUNG VON WASSERVERSORGUNGEN),
Ingenieurburo Grombach G.m.b.H., Bad Homburg (Germany, F.R.).
J. Franz.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 2, p 45-52, February, 1981. 5 Fig, 3 Tab, 7 Ref. English abstract.

Descriptors: *Water conveyance, *Automation, *Cost-benefit analysis, *Process control, *Computers, Federal Republic of Germany, Data processing, Computer programs, Design criteria, Costs, Capital costs, Planning, Long-term planning, Utilities, Operating conditions, Water distribution.

Questions to be considered regarding the installation of a central control and monitoring facility for water supply centers cannot usually be answered for the industry as a whole; specific technical and operating conditions for each plant are the deciding factors. For operating conditions, questions to be considered include choice of facility design, cost-benefit ratio, whether multiple utilities (e.g., water and gas) should share the facility, whether a process control computer is needed (and if so, whether one or two computers should be installed), the choice of operating display panel, and programming problems. When deciding on design, long-range goals must be considered to avoid building a system that will soon be inadequate. (Gish-FRC)
W83-03449

BERLIN WATER '81 -- 125 YEARS OF CENTRAL WATER DISTRIBUTION (WASSER BERLIN '81 -- 125 JAHRE ZENTRALE WASSERVERSORGUNG),
Berliner Entwasserungswerke (Germany, F.R.).
H. Teesendorff.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 3, p 97-102, March, 1981. 3 Fig, 9 Ref. English abstract.

Descriptors: *Water conveyance, *Wastewater treatment, *Water treatment facilities, *Wastewater facilities, *History, Federal Republic of Germany, *Berlin, Water quality control, Automation, Water distribution, Groundwater, Drinking water, Groundwater recharge, Eutrophic lakes, Tegeler See, Water demand, Water pollution, Spree river.

The first water works in Berlin (Federal Republic of Germany) began operation in 1856, and wastewater disposal began in 1878. At the beginning of the 20th century, methods of removing iron and manganese compounds permitted the use of groundwater for drinking, and the city was enabled to eliminate the use of surface water for this. By 1939, the city, together with a private company, supplied 4.3 million residents with 230 million cu m water per year. When the city was split in 1949, West Berlin was left with only 7 of the 16 waterworks, which supplied < 500,000 cu m/day, to supply two-thirds of the original city residents. The capacity of the seven waterworks is now 1,140,000 cu m/day; the pure water storage capacity was expanded from 185,000 to 370,000 cu m, and the sewer system increased from 3,777 to 4,500 km. Since 1949, about 880 million DM has been spent on the water supply system, approximately half of this in the last 10 yr. The city expectes to cover demand for some time, since demand is projected to rise < 1% in the next 10 yr. Mechanization is continually being instituted, though only one facility (Kladow) is fully automated with process control (other facilities are partially automatic). All Siphon wells were converted to run under their own power between 1964 and 1980, and the number of pumps was reduced about 1,000 to 406, even though pumping capacity increased twofold since 1950. The use of groundwater for drinking is made possible by favorable hydrogeology: sand and gravel deposits provide large quantities of good-quality water. Artificial recharge is conducted by means of percolation basins; up to 30 million cu m of mechanically treated surface water per year is returned to the ground, and this amount will eventually be increased to 70 cu m/yr. (Gish-FRC)
W83-03455

DEVELOPMENT AND STATUS OF EMERGENCY DRINKING WATER SUPPLY IN THE FEDERAL REPUBLIC OF GERMANY AFTER PASSAGE OF THE WATER SAFEGUARDING LAW (ENTWICKLUNG UND STAND DER TINKWASSER-NOTVERSORGUNG IN DER BUNDESREPUBLIK NACH DEM WASSERSICHERSTELLUNGSGESETZ),
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
W. Such, and W. Hampel.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 9, p 402-410, September, 1981. 5 Fig, 1 Tab, 12 Ref. English abstract.

Descriptors: *Water supply, *Civil defense, *Water law, *Governmental interrelations, Legal aspects, Political aspects, Interagency cooperation, *Public health, *Drinking water, Wells, Pipelines, Urban areas, Federal Republic of Germany.

The Federal Republic of Germany is required by law to provide the public with an emergency water supply during times of war or other disruptions. In compliance with the Law on Safeguarding Water Supply, approximately 3528 solitary wells have been constructed or reconstructed, independent of the public water supply. The program, Emergency Water Supply by Wells and Springs, went into effect on December 31, 1979 and serves most large cities an urban areas (about 14.93 million inhabitants). The Federal Ministry of the Interior has ordered the construction of interconnecting emergency pipelines with a total length of about 390 km at a cost of 105.6 million DM as part of the water program within the Federal investment program. (Author's abstract)
W83-03458

POSSIBILITY OF REDUCING ENERGY COSTS FOR WATER CONVEYANCE USING A PRELIMINARY RESERVOIR (EINSPARMOGLICHKEIT AN ENERGIEKOSTEN ZUR WASSERFORDERUNG DURCH EINSATZ EINES VORBEHALTERS),
For primary bibliographic entry see Field 8A.
W83-03459

USE OF POLYETHYLENE IMINES IN FLOTATION AND IMPROVING THE FILTRATION OF SUSPENSIONS OF BLUE-GREEN ALGAE,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. C. Volkova, N. V. Khominskaya, V. M. Grashchenko, and S. A. Azoyan.
Hydrobiological Journal, Vol 18, No 1, p 59-63, 1982. 3 Tab, 3 Ref.

Descriptors: *Algae, *Polyethylene imines, *Filtration, *Water treatment, Cyanophyta, Flotation, Flocculation, Organic compounds, Algae harvesting.

Polyethylene imines (PEI) with molecular weights of 30,000 to 80,000 were tested as flotation-filtration aids for water containing cyanophytes. Filtration was somewhat faster with the 30,000 and 60,000 molecular weight PEI than with the 80,000 molecular weight PEI. Most effective was the 60,000 molecular weight PEI. Optimum concentration of PEI for filtration was 5-10 mg per liter of suspension. Optimum concentration of algal dry matter for filtration was 6-10 g per liter. Floc formation took place immediately after addition of PEI. (Cassar-FRC)
W83-03471

DRINKING WATER CONTAMINATION WITH CHLORO-ORGANIC COMPOUNDS: SOURCES, HEALTH EFFECTS, CONTROL (CONTAMINAZIONE DELLE ACQUE POTABILI DA COMPOSTI CLORO-ORGANICI: ORIGINE, EFFETTI BIOLOGICI, MISURE DI PROTEZIONE E DI CONTROLLO),
Milan Univ. (Italy). Inst. of Hygiene.
G. Ziglio, and A. Giovanardi.
Igiene Moderna, Vol 75, No 4, p 395-426, April, 1981. 2 Tab, 66 Ref.

Descriptors: *Chlorinated hydrocarbons, *Drinking water, *Water quality control, Hydrocarbons, Water quality, Water pollution sources, Water pollution prevention, Tricholoethylene, Chloroform, Pesticides, Chlorination, Trihalomethanes, Industrial wastes, Water treatment, Hazardous materials, Milan, *Italy.

US studies as well as those performed in Milan (Italy) have demonstrated the frequent contamination of drinking water sources with chloro-organic compounds. Compounds such as trichloroethylene, chloroform, and pesticides reach water supplies through their manufacture or industrial and agricultural use. Trihalomethanes are formed during the chlorination process. Some of these compounds are carcinogens, so there is no risk-free level. Thus, contaminated drinking water must be monitored, and pollution sources must be identified, contaminated wells reclaimed, and uncontaminated sources discovered. Emergency means for reducing chloro-organic levels are needed. In the case of trihalomethanes, the removal of precursors is possible as well as modifications in the chlorination process. Also, alternative disinfectants can be used. The removal of contaminating compounds before the water reaches treatment and distribution is effective but expensive. (Small-FRC)
W83-03476

PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERISTICS OF LAKE OMODEO, PART II: POSSIBILITY OF USING IMPOUNDED WATER FOR SUPPLYING ORISTANO CITY (FENOMENI BIOLOGICI DI UN LAGO ARTIFICIALE DI ANTICA DATA: LAGO OMODEO, NOTA II: SULLA POSSIBILITA DI UTILIZZARE LE ACQUE DELL'INVASO PER LA ALIMENTAZIONE IDRICA DELLA CITTA DI ORISTANO),
Cagliari Univ. (Italy). Ist. di Igiene.
A. Contu, A. M. Cioglia, G. Pinducciu, M. Schintu, and M. L. Lintas.
Igiene Moderna, Vol 77, No 2, p 216-227, 1982. 3 Tab, 4 Ref.

Descriptors: *Oil industry, Water pollution, *Lakes, Rivers, Chemical analysis, Water analysis, Toxicity, *Water pollution sources, Aqueducts, Water supply development, *Italy, Lake Omodeo.

Investigations of the physical, chemical, and biological characteristics of Lake Omodeo effluent were extended to determine possible pollution generated by Ottana petrochemical plants. Tirso lower course waters were also investigated as a possible alternative to feed the Oristano aqueduct. Chemical pollution was absent in the lake effluent and at low levels in the river. Lake water normally has better and more stable characteristics so it is preferable for the aqueduct. Controls on wastes from the Ottana plants are necessary to avoid toxic pollution of Omodeo. Direct utilization of lake water is advisable to avoid any further variability and the pollution of the lower Tirso. (Author's abstract)
W83-03477

5G. Water Quality Control

EFFECT OF AQUATIC MACROPHYTES ON PHYSICO-CHEMICAL PARAMETERS OF AGRICULTURAL DRAINAGE WATER,
Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy, P. D. Sacco, D. A. Graetz, K. L. Campbell, and K. M. Portier.
Journal of Aquatic Plant Management, Vol 21, p 1-7, January, 1983. 5 Fig, 4 Tab, 15 Ref.

Descriptors: *Macrophytes, *Elodea, *Dissolved oxygen, *Agricultural runoff, *Physicochemical properties, *Water hyacinth, *Water quality control, Turbidity, Chemical oxygen demand, Water temperature, Water quality management, Hydrogen ion concentration, Alkalinity, Carbon dioxide, Biological oxygen demand, Conductivity.

The effect of aquatic macrophytes cultured in experimental reservoirs and flooded fields of the physico-chemical properties of treated and untreated agricultural drainage water was monitored over a period of 27 months. Allowing drainage water to flow through a reservoir stocked with waterhyacinths decreased dissolved oxygen (DO), temperature, pH, conductivity (EC), turbidity, and alkalinity, but increased dissolved carbon dioxide (CO_2). Drainage water flowing through reservoirs stocked with elodea or cattails exhibited increased DO, pH, temperature, CO_3 alkalinity and turbidity but decreased dissolved CO_2, HCO_3 alkalinity and EC compared with untreated water. Water flowing through reservoirs stocked with waterhyacinths showed marked decreases in biological oxygen demand and chemical oxygen demand compared with other treatment systems. In water flowing over flooded fields, DO, EC, pH and temperature were increased, but dissolved CO_2, HCO_3 alkalinity, and turbidity were decreased compared with untreated water. (Geiger-FRC)
W83-03153

EFFECTS OF SIMAZINE TREATMENT ON CHANNEL CATFISH PRODUCTION AND WATER QUALITY IN PONDS,
Delta Branch Experiment Station, Stoneville, MS.
C. S. Tucker, R. L. Busch, and S. W. Lloyd.
Journal of Aquatic Plant Management, Vol 21, p 7-11, January, 1983. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Herbicides, *Water pollution effects, *Aquatic weed control, *Water quality control, *Catfish farming, Aquatic weeds, Carbon dioxide, Dissolved oxygen, Nitrogen, Nitrite, Ammonia, Pesticides, Catfish, Fish farming.

The effects of a single simazine treatment (1.3 milligrams/liter) on channel catfish production and water quality was investigated in ponds infested with Chara vulgaris. Following herbicide treatment, dissolved oxygen levels decreased, and total ammonia-nitrogen, nitrite-nitrogen, and carbon dioxide levels increased. These effects were most pronounced the second week after treatment. Fish production was reduced 20% in treated ponds compared to control ponds, even though affected variables did not reach lethal limits. The single dose of simazine completely eliminated Chara infestations within 2 to 3 weeks. (Geiger-FRC)
W83-03167

PHYSIOCHEMICAL PRETREATMENT OF LANDFILL LEACHATES USING COAGULATION,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
C. S. Slater, C. G. Uchrin, and R. C. Ahlert.
Journal of Environmental Science and Health, Part A, Vol 18, No 1, p 125-134, 1983. 4 Fig, 1 Tab, 20 Ref.

Descriptors: *Coagulation, *Industrial wastes, *Leachates, Turbidity, Polyelectrolytes, Wastewater treatment, *Landfills, Lime.

Lime was the most effective pretreatment coagulent for the aqueous phase of a high strength industrial landfill leachate of complex and undefined composition. A treatment with 6.0 g of lime per liter of leachate reduced turbidity of 130 NTU by 98%, total organic carbon of 9850 mg per liter by 6%, COD of 22,900 mg per liter by 10%, and iron of 200-2000 mg per liter by >99%. Studies with alum, ferric chloride, and magnesium oxide showed that none were as effective as lime. Addition of the polyelectrolyte Magnifloc 570 sharply increased the rate of turbidity reduction during the first 20 min of detention. Another leachate sample with a higher concentration of dispersed oil in the aqueous phase had a much slower rate of turbidity reduction even with addition of polyelectrolytes to the lime. After 10 min of settling, the anionic polyelectrolyte Primafloc A-10 plus lime reduced supernatant turbidity by 95% compared to lime alone, which gave a 9% reduction. Cationic polymers produced a 40-60% reduction with a detention time of 10 min. (Cassar-FRC)
W83-03172

HORSES IN SUBURBIA,
Fairfield County Conservation District, Monroe, CT.
K. Decker.
Journal of Soil and Water Conservation, Vol 38, No 1, p 21-22, January-February, 1983. 2 Fig.

Descriptors: *Animal wastes, *Erosion control, Horses, *Connecticut, Soil erosion, Wind erosion, Manure, Runoff, Groundwater contamination, Water quality.

The high horse population in Fairfield County, Connecticut, poses two threats to water quality in the area. The first concerns manure storage and disposal and the second concerns erosion and sedimentation from horse sites. To encourage good waste management and to mitigate or prevent potential pathogen contamination of soil and water resources, public health regulations require storage specifications, maintenance practices, and regular use of disposal procedures for horse manure. Watershed sanitation regulations prohibit accumulation of manure within specified proximities of reservoirs, watercourses, wetlands, and watersheds. The major problem caused by horse wastes occurs when such wastes become a source of nutrient pollution. As such horse wastes can enter wetlands, watercourses, ponds, and groundwater through runoff, altering or damaging the environment by overfertilizing aquatic vegetation, There appears to be three major horse-related land uses subject to erosion: horse lots, bridle trails, and grazing pastures. At some public and semipublic stables there is erosion or the potential for erosion in parking areas and on drives. Some erosion sites result in sedimentation in nearby ponds and watercourses. Still other sites were experiencing wind erosion from large outdoor rings. In general the response of the the owners of the horses to offers of education and assistance in maintaining their land has been positive. (Baker-FRC)
W83-03176

QUANTITATIVE MODELS AND ANALYSIS OF URBAN NONPOINT SOURCE WATER POLLUTION CONTROL SYSTEMS,
Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
For primary bibliographic entry see Field 6A.
W83-03184

GROUNDWATER PURIFICATION BY INFILTRATION OF OZONIZED WATER (GRUNDWASSERSANIERUNG DURCH INFILTRATION VON OZONTEM WASSER),
Karlsruhe Univ. (Germany, F.R.).
G. Nagel, W. Kuhn, P. Werner, and H. Sontheimer.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 8, p 399-407, August, 1982. 10 Fig, 3 Tab, 14 Ref. English Summary.

Descriptors: Contamination, Pollutants, *Chlorination, *Groundwater, *Groundwater management, Oil pollution, Ozone, Organic compounds, Wells, Treated water, Sanitation, Technology, Biodegradation, Degradation, Groundwater barriers, Groundwater pollution, *Infiltration, *Federal Republic of West Germany.

Since 1980, the city waterworks of Karlsruhe has been using a new treatment technology for the sanitation of oil-polluted groundwater in one of their groundwater works. This sanitation project has already shown success. Water from the most polluted well is treated with ozone and infiltrated again through the contaminated ground. In the infiltration area a barricade against the polluted groundwater is built. Analytical data show no contamination of the groundwater following this process; tests to determine oxygen, organic carbon, and cyanide concentrations were conducted. The ozone process has the further advantage of reducing bacterial pollution. No chlorination or further treatment of this groundwater is required before public distribution. (Titus-FRC)
W83-03200

ASSESSING ENVIROMENTAL IMPACTS OF OPEN WATER DISPOSAL OF DREDGED SEDIMENT,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 6G.
W83-03251

COMPUTER SIMULATION OF LOCAL DESTRATIFICATION IN RESERVOIRS,
Oklahoma State Univ., Stillwater. Dept. of Mechanical and Aerospace Engineering.
D. G. Lilley, and A. A. Busnaina.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219931, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Oklahoma State Univ., Stillwater, May 1983. 58 p, 29 Fig, 1 Tab, 23 Ref. OWRT A-098-OKLA(1), 14-34-0001-1138.

Descriptors: *Computer models, Computer programs, *Stratification, Hydraulic models, *Reservoir releases, Reservoir construction, *Reservoir design, Mathematical analysis, *Mixing, Model studies, Water quality, *Jets, Stratified flows, Hydraulics, Lakes, Lake restoration, Reservoirs, Mathematical models, Hydrodynamics, Water quality control, Water quality standards, Water storage, *Destratification.

Stratification of lakes and reservoirs is a very common and typically undesirable problem during the hot summer months when the hypolimnion (bottom layer of water) becomes severely anerobic (oxygen deficient). This is harmful to biological life not only in lakes and reservoirs, but also in downstream river flow from the low-level release structure associated with the large mass of water. The Garton Pump consists of a low-energy axial flow propeller placed just below the surface so as to provide a downward directed jet of fluid and thereby locally mix reservoirs near the release structure of the dam. In this way high-quality epilimnion water is transported downwards, so obtaining local destratification and improved release water quality in the vicinity of low-level release structures. A comprehensive numerical simulation has been developed which is directly applicable to the practical situation. It complements associated experimental and empirical modeling programs. The flowfield is fully three-dimensional and a simplified numerical simulation and solution procedure has been formulated in Cartesian coordinates to include species diffusion and buoyancy forces. Both laminar and turbulent flow situations can be handled. Comparison of predictions with experimental data confirms that the main dynamic effects are modeled adequately and better than a previous two-dimensional simulation. This fundamental study with practical applications represents a low cost basic tool to show the influence of design parameters on the practical flowfield.
W83-03279

ARTIFICIAL DESTRATIFICATION TO PREVENT WINTERKILL,
Iowa State Univ., Ames. Dept. of Animal Ecology.
R. C. Summerfelt, and T. K. Cross.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220368, Price codes: A06 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute Completion Report No 113, Ames, March 1983. 93 p, 29 Fig, 15 Tab, 36 Ref, 2 Append. OWRT A-076-IA(1), 14-34-0001-0117.

Descriptors: Water quality, Lakes, *Aeration, *Destratification, Biochemical oxygen demand, Dissolved oxygen, Chlorophyll, *Winterkill, Oxygen depletion, *Lake restoration, Pumping, *Iowa, McFarland Lake, Horticulture Lake.

Although nearly all prior efforts to prevent winterkill of the fish populations of lakes by means of artificial aeration have been done during the ice-covered interval, the present study was undertaken to evaluate the hypothesis that artificial destratification by mechanical mixing during the summertime would reduce biochemical oxygen demand (BOD) at the onset of the ice-covered interval sufficiently to prevent wintertime anoxia and a fish kill. A low energy, axial-flow pump was used. Summertime pumping artificially destratified the experimental lake within 24 hours and, and with few exceptions, maintained at least 2 mg/l dissolved oxygen in the overlying, near-bottom stratum throughout the summer months. Both the oxygen and temperature of the near-bottom stratum was significantly higher during the summer's pumping than either before or after. As measured by concentration of chlorophyll a and Secchi disk transparency, algal blooms were moderated by pumping. Over the four years of aeration, there was an exponential decline in the volume weighted mean lake concentration of BOD that was present at the commencement of ice-cover in relation to the average percentage of the lake volume pumped during the summer period. Winterkill did not occur during the winters following summer pumping, whereas severe winterkill occurred the winter before pumping commenced and the winter following the post-pumping summer when pumping was not done.
W83-03299

EFFECTS OF SILVICULTURAL PRACTICES ON WATER QUALITY IN NORTHERN WISCONSIN,
Wisconsin Univ.-Stevens Point. Coll. of Natural Resources.
N. E. Spangenberg, and R. McLennan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220517. Water Resources Center Technical Report WIS WRD 83-07, Univ., of Wisconsin, Madison, 1983. 17 p, 3 Fig, 2 Tab, 15 Ref. OWRT A-095-WIS(1), 14-34-0001-2153.

Descriptors: *Cutting management, *Forest management, *Forest watersheds, *Soil erosion, *Water quality, Clear-cutting, Forest soils, Forestry, Mixed forests, Streams, *Wisconsin, Chequamegon National Forest.

Two areas in the Chequamegon National Forest were selected for studies of water quality and overland soil movement. One area, bordered on the North by the Marengo River, is a clearcut in a mixed hardwood stand with two small streams running through it. The second area is mixed hardwoods being logged with a selection cut. A stream runs through the active cutting area. Sample transects were established in the streams running through and bordering the timber harvest areas. Samples were collected at 2-week intervals and analyzed. Amounts of soil exposure and vegetative ground cover were estimated at random points along transects established in harvested and unharvested areas. Soil/vegetation data were collected at 2-week intervals. During the first growing season after clearcutting, there were few significant changes in water quality that could be attributed to the timber harvest. Soil disturbances caused by rubber tire skidders were virtually healed. Logging debris and vegetation produced almost 100% groundcover early in the growing season. This provided a high degree of soil protection, which minimized soil erosion during the first growing season. Selection cut harvesting with rubber tire skidding had no impact on water quality in the first growing season after the harvest. Harvesting exposed a minimum of soil and the amount of vegetative cover did not change. It is doubtful that selection cutting increased soil erosion on the site during the first growing season.
W83-03304

WATER QUALITY OF THE UPPER SPOKANE RIVER AND EVALUATION OF METHODS FOR MEASUREMENT OF THE EFFECT OF EFFLUENT UPON PRIMARY AND SECONDARY PRODUCERS,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5A.
W83-03317

FLOOD CONTROL EFFECTIVENESS OF SYSTEMS OF DUAL PURPOSE DETENTION BASINS,
New Jersey Dept. of Environmental Protection, Trenton.
For primary bibliographic entry see Field 4A.
W83-03350

COMPARISON OF RESERVOIRS WITH DISSIMILAR SELECTIVE WITHDRAWAL CAPABILITIES: EFFECTS ON RESERVOIR LIMNOLOGY AND RELEASE WATER QUALITY,
Army Engineer District, Portland, OR.
D. W. Larson.
Canadian Water Resources Journal, Vol 7, No 2, p 90-111, 1982. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Reservoirs, Construction, *Environmental effects, Fish, Wildlife, Recreation, Financial aspects, Water quality, Turbidity, Conduits, *Oregon, Lost Creek Reservoir, Hills Creek Reservoir, Planning, Decision making.

The effects of outlet structures and operational modes on reservoir limnology and on the quality of water released downstream were investigated. The subjects of the study were two reservoirs, Hills Creek in the Willamette River Basin and Lost Creek on the Rogue River, which are similar morphometrically but which have strikingly different water withdrawal capabilities. At Lost Creek Reservoir, selective withdrawal capability was increased immensely by the addition of a turbidity conduit, facetiously called an elephant truck, for rapid, downstream disposal of turbid inflows whenever river turbidity throughout the Rogue Basin was naturally high because of frequent winter storms and high streamflow conditions. The decision to add the conduit came late in the Project's development, actually near the end and after considerable debate. The cost of the conduit was about $150 million. In view of the fact that the Rogue River is one of the few remaining wild and scenic rivers in the contiguous US and because it is recognized internationally for its anadromous fish runs and unusually high water quality, the monetary cost of measures aimed at providing adequate protection for this valuable resource was considered justified. (Baker-FRC)
W83-03422

MULTIPURPOSE USE OF AN EUTROPHIC SOUTH AFRICAN MAN-MADE RESERVOIR,
Hydrological Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 6D.
W83-03425

NUTRIENT CONTENTS AND ALGAL GROWTH IN AN IMPOUNDED RIVER: EFFECTS ON OXYGEN BALANCE AND NEED FOR NUTRIENT RETENTION (NAHRSTOFFGEHALTE UND ALGENWACHSTUM IN EINEM GESTAUTEN FLUSS, AUSWIRKUNGEN AUF DIE SAUERSTOFFBILANZ UND NOTWENDIGKEIT DES NAHRSTOFFRUCKHALTES),

For primary bibliographic entry see Field 5C.
W83-03454

CONTROL OF ALGAL DOMINANCE THROUGH CHANGES IN ZOOPLANKTON GRAZING, LAKE WASHINGTON: PHASE I,

Washington Univ., Seattle. Office of Public Archaeology.
H. J. Hartmann.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83-226878, Price codes: A05 in paper copy, A01 in microfiche. Water Research Center Completion Report, Washington State Univ., Pullman, May 1983. 76 p, 16 Fig, 14 Tab, 46 Ref. OWRT B-089-WASH(1), 14-34-0001-1277.

Descriptors: Zooplankton, Phytoplankton, *Dominant organisms, *Algal control, Selectivity, *Nutrient requirements, Phosphorus, *Feeding rates, Phosphorus radioisotopes, Annual succession, Biomass, Epilimnion, Cycling nutrients, Diatoms, Chlorophyta, Cyanophyta, Cultures, Daphnia, Copepods, Water quality control, Fish management, *Washington, Lake Washington, *Selective feeding, *Phosphorus recycling, Daphnia pulicaria, Diaptomus ashlandi, Stephanodiscus hantzschii, Ankistrodesmus sp., Oscillatoria limnetica, Lake Washington, Lake management.

Mechanisms by which selective grazing and phosphorus recycling regulate phytoplankton abundance and succession were investigated. Food preferences of a cladoceran (Daphina) and a copepod (Diaptomus) on paired mixtures of a centric diatom (Stephanodiscus), a green (Ankistrodesmus) and a filamentous blue-green alga (Oscillatoria) were compared in double-isotope (P32/P33) feeding studies; phosphorus-limited growth and nutrient uptake of the algae were compared in batch-culture experiments. Zooplankton food selectivity and algal phosphorus uptake were size- and species-specific: Single-cell ingestion rates of small Daphina and adult copepods were similar, while large Daphnia ingested 1.6 times more cells/weight than Diaptomus. Daphina selected diatoms over green algae over a wide cell-concentration range (50 to 50,000 cells/ml). Selectivity was more significant in small than in large Daphnia. Diaptomus and large Daphnia rejected blue-green filaments against single cells, while small Daphnia could not reject filaments. Ankistrodesmus removed phosphate faster from the environment, grew faster and depleted internal phosphorus quicker than Stephanodiscus or Oscillatoria. Zooplankton changes in Lake Washington would be expected to influence dominance of centric diatoms, green, and similar single-celled algae, but are unlikely to affect abundance of filamentous blue-green algae.
W83-03467

AUTOMATION IN WASTEWATER TECHNOLOGY AND WATER QUALITY. PRACTICAL EXPERIENCE WITH CONTROL, REGULATION, AND AUTOMATION IN SEWER SYSTEMS, WASTEWATER TREATMENT, AND WATER QUALITY CONTROL (AUTOMATION IN DER ABWASSERTECHNIK UND GEWASSERGUTE. PRAKTISCHE ERFAHRUNGEN BEI DER STEUERUNG, REGELUNG UND AUTOMATION BEI DER ABWASSERABLEITUNG, ABWASSERBEHANDLUNG UND GEWASSERGUTEUBERWACHUNG,

Technische Univ., Munich (Germany, F.R.). Lehrstuhl und Pruefamt fuer Wassergutewirtschaft und Gesundheitsingenieurwesen.
For primary bibliographic entry see Field 5D.
W83-03469

SURFACE WATER QUALITY IN THE BORDER AREA BETWEEN EL PASO AND THE GULF OF MEXICO,

Texas Univ. at Austin. Dept. of Environmental Engineering.
G. A. Rohlich.

Natural Resources Journal, Vol 22, No 4, p 915-923, October, 1982. 2 Tab, 11 Ref.

Descriptors: *Water quality, *Water managemet, *Rio Grande, *Texas, *Mexico, Resources management, Reservoirs, Urbanization, Population dynamics, Surface water, Water pollution, Land use, Water pollution sources, Irrigation practices, Water quality management.

The present and future water quality problems in the portion of the Rio Grande between El Paso and the Gulf of Mexico are discussed. Water quality is influenced by climate, geology, streamflow characteristics, diversions, impoundments, land use, irrigation practices, discharge of municipal and industrial effluents, and inflow from nonpoint sources. Water quality of the International Amistad Reservoir was excellent, and quality of tributaries was good. The Pecos River had the highest mineral content and the Rio Grande the highest organic content. Water quality of the Falcon Reservoir and below to the Brownsville area is also good. Future developments may adversely affect water quality, primarily because of increases in population and urbanization. Growing municipal and industrial demands will impose a severe burden on surface water resources. Costs and benefits of future developments must be analyzed. (Small-FRC)
W83-03500

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

QUANTITATIVE MODELS AND ANALYSIS OF URBAN NONPOINT SOURCE WATER POLLUTION CONTROL SYSTEMS,

Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
A. O. Esogbue.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83-214940, Price codes: A10 in paper copy, A01 in microfiche. Environmental Resources Center Report No ERC 04-83, Georgia Institute of Technology, Atlanta, April 1983. 217 p, 20 Fig, 30 Tab, 55 Ref, 3 Append. OWRT B-147-GA(1), 14-34-0001-0215.

Descriptors: *Algorithms, Best management practices, Evaluation, Fuzzy clustering algorithms, Fuzzy sets, Management, Multilevel hierarchical model, *Nonpoint source water pollution, Public participation, Statistical analysis, Cost effectiveness, *Water pollution control, Systems analysis, *Georgia, Atlanta.

Agencies designated to implement the Clean Water Act of Public Law PS 72-500, Section 208 often encounter difficulties associated with the management of systems consisting of complex interactions of soft and imprecisely stated phenomena. Two such major areas in this implementation process concern the use of the publics in water resources plan formulation and the use of the so called best management strategies in the control of nonpoint source water pollution. The quantitative analysis of these systems as well as the development of quantitatively based models for measuring their effectiveness is the subject of the inquiry whose results are reported here. The central thesis is that because of the presence of soft imprecise variables, any qualification efforts should invoke the tools of fuzzy set theory. To prove this point, the goals of State Planning Agencies particularly relative to Erosion and Sedimentation Control were reviewed and the problems inhibiting compliance highlighted. The essentially fuzzy variables and phrases were syphoned out and a plan to minimize the fuzziness developed. The use of the publics in water resources planning was next considered leading to the development of a working definition of their effectiveness. A fuzzy multi-level hierarchical model which provides a pessimistic as well as an optimistic measure of this effectiveness was then developed and validated using the Water Resources Advisory Group of the Atlanta Regional Commission as the leitmotif. Various fuzzy clustering algorithms were developed to group the field data. This model was also used to analyze the contributions of various hypothesized variables (factors) on the total system effectiveness of public participants and planners. A comprehensive list of BMPs in use in the State of Georgia as well as in the nation was developed and a statistical analysis of their effectiveness performed. Effectiveness was approached both from the system and cost effectiveness perspectives. The total effectiveness of BMPs as a control approach for nonpoint source pollution was assessed using a modification of the fuzzy multilevel model. As in the public participation effectiveness measurement, the contributions of each design principle to total system and cost effectiveness were determined. A statistical analysis of the importance and effectiveness of each BMP was also performed leading to a ranking of these BMPs, structural and nonstructural, in terms of their effectiveness.
W83-03184

MULTIPLE USE RESERVOIR PLANNING APPROACHES: LAC SEUL, NORTHWESTERN ONTARIO,

Hough, Stansbury and Michalski Ltd., Toronto (Ontario).
A. J. Usher, and M. F. P. Michalski.

Canadian Water Resources Journal, Vol 7, No 2, p 350-364, 1982. 1 Fig, 5 Ref.

Descriptors: *Water resources development, *Planning, *Public participation, *Management, Water management, Reservoirs, Financial aspects, Conjunctive use, Benefits, *Ontario, Lac Seul, *Multiple use reservoir planning.

Preparation of alternative resource management strategies for Lac Seul required a novel planning approach to deal with interdependence and competition among resource uses and users. Competition between regulation for power generation on the one hand and fisheries, recreation, amenities, and wild rice on the other was of particular concern. Four alternative strategies were developed which would allow government and public to consider the questions of broad policy objectives, and beneficiaries of resource development. Problems limiting the effectiveness and acceptability of the planning approach are reviewed, and planning and management directions applicable to multiple use reservoirs as well as to other multiple use land and water areas are suggested. The outcome of the studies suggests that planners and managers must become more committed to economic analysis, including marginal analysis, of the benefits and costs of various resource uses if they wish to more closely approach optimal management of reservoirs and other land and water areas. No one government agency can be responsible for all aspects of resource planning and management. There will always be controversy and conflict among resource user communities over competing objectives and uses. However, if resource management agencies commit themselves to laying all the cards on the table for public scrutiny, these controversies and conflicts are likely to be dealt with most straightforwardly and effectively. (Baker-FRC)
W83-03211

MATHEMATICAL MODEL FOR LONG-TERM WATER SUPPLY PLANNING (MATHEMATISCHES MODELL FUR DIE LANGFRISTIGE WASSERVERSORGUNGSPLANUNG),

Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
H. A. Billib.

Wasserwirtschaft, Vol 71, No 1, p 16-18, January, 1981. 2 Fig, 1 Tab, 9 Ref. English Abstract.

Descriptors: *Planning, *Water supply, *Operating costs, *Systems analysis, *Mathematical models, Long-term planning, Costs, Optimization, Model studies, Investment, Economic aspects, Hanover, *Federal Republic of Germany.

Long term water supply planning involves problems of sequencing and scheduling of alternative or interconnected projects, optimizing the time of investment for a project set, and minimizing operational costs. To solve this complex capacity expansion problem a multilevel problem is conceived, which connects different methods of operations research. For the first level, the sequence of potential projects, the technique of heuristic approximation is applied. Then dynamic programming is used to determine the optimal investment schedule for a given new project. Finally, through linear programming the project with maximum capacity is identified. An example of this technique applied to a plant near Hanover is presented. Further research is proposed in which additional dimensions of the problem are incorporated and sensitivity analysis is performed on the results. (Titus-FRC)
W83-03224

ESTIMATION OF THE ECONOMIC WORTH OF WATER FOR RELEASE DECISIONS,
Oklahoma State Univ., Stillwater. Dept. of Management.
R. Sharda.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219949. Water Resources Research Institute Completion Report, Oklahoma State Univ., Stillwater, April 1983. 90 p, 28 Fig, 8 Tab, 36 Ref. OWRT A-104-OKLA(1), 14-34-0001-1138.

Descriptors: *Cost benefit analysis, *Travel time, *Navigation, *Benefits, *Multiobjective planning, *Recreation, *Recreation demand, *Reservoir releases, *Time series analysis, Flow control, Flow discharge, Optimization, Multipurpose reservoir, Multireservoir networks, Reservoir operation, *Oklahoma, Arkansas River.

Optimization of a multipurpose reservoir system operation can be accomplished through mathematical programming only if the benefits and costs of the operation are known. A number of mathematical programming applications use the hydropower generation as the objective (as it is easily quantifiable) and incorporate the other purposes through constraints. This study attempted to relate release decision variables to recreation benefits and navigation costs on the McClellan-Kerr Arkansas River Navigation System. These relationships can then be used in a mathematical programming model for release decisions. This report describes one of the few applications of the Box-Jenkins multiple time series methodology to recreation and water level data. The results indicate that the water level of the area lakes has a significant positive relationship with visitor days. Real income in Oklahoma was also found to be an important variable in explaining the variation in visitor-days. This presents questions such as whether the reservoirs system should be operated to maximize income producing purposes like navigation and hydropower generation, or to consider recreation benefits explicitly in the operation planning. In modeling navigation benefits, a weak evidence exists that flow reduces travel time for boats linearly on downward trips but has a quadratic relationship with travel time on upward trips. Work is in progress to convert these relationships into dollar costs of flow regulation. Overall, the project developed a framework for a real life application of optimization models by first developing the appropriate costs/benefits.
W83-03280

INDEX CONSTRUCTION FOR MULTIPLE OBJECTIVE ANALYSIS OF LAND AND WATER USE IN A HIGH MOUNTAIN WATERSHED,
Utah Water Research Lab., Logan.
L. D. James, D. T. Larson, M. McKee, J. J. Messer, and T. Twedt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220004, Price codes: A16 in paper copy, A01 in microfiche. Completion Report, May 1983. 252 p, 14 Fig, 41 Tab, 103 Ref. OWRT C-80129-P(No 8407), 14-34-0001-8407.

Descriptors: *Comprehensive planning, *Multiobjective planning, *Land use, Wilderness areas, Wildlife habitats, Recreation, Phosphate mining, *Indexing, Indicators, Attributes, Hunting, Fishing, Forest watersheds, Snowmelt, Natural streams, Water quality, *Watershed management, *Idaho, Upper Blackfoot watershed, Mountain watershed.

The objective of this study was to use the Upper Blackfoot watershed in the mountains of Southeastern Idaho as an arena for developing methods for construction, refinement, and application of indices needed to design land and water management schemes, compare alternatives, and influence the public in their uses of the area. A total of 21 uses were examined on 343 land units of a 160 square-mile area ranging in elevation from 6300 to 9000 feet and where the principal activities of grazing, lumbering, mining, and recreation can only be undertaken in the summer after the snow has melted. The indices considered were a reasonability index for screening out unreasonable uses at the start of the planning process, an index of use intensity for estimating an amount for reasonable uses, and an index for estimating the utility of the amount of use made from the public viewpoint. Data were collected on 43 attributes for the 343 land units and used in a linear programming model to maximize 1) economic benefits from use of the area, and 2) minimize environmental disturbance. The resolution in the available use data limited the model solution to allocating uses among 18 larger land units. The primary factor limiting the modeling, however, was the lack of information for defining the interactions among the uses. The analysis provides a framework for classifying and identifying interactions beginning with the simplest case of simultaneous use by two uses in near proximity.
W83-03286

REAL-TIME FORECASTING OF RIVER FLOWS AND STOCHASTIC OPTIMAL CONTROL OF MULTIRESERVOIR SYSTEMS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 4A.
W83-03323

TOWARD AN ECONOMETRIC MODEL TO ANALYZE IMPACTS OF WATER AVAILABILITY ON THE OREGON ECONOMY,
Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economics.
G. W. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83 221796. Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Institute completion report, Oregon State University, Corvallis, May 1983. 204 p, 16 Tab, 79 Ref, 1 Append. OWRT A-055-ORE(1). 14-34-0001-1139.

Descriptors: *Econometrics, *Econometric models, *Regional models, Income, Prices, Employment, Agriculture, Simulation, *Oregon economy, Oregon gross product.

A macro-econometric model was developed relating the performance of Oregon agriculture, the state's most water-dependent industry, to the performance of Oregon's economy. Linkages between Oregon's agricultural sector, the national economy, and private non-farm sectors of the Oregon economy were emphasized, particularly the latter two elements. The model, with 102 equations, has separate blocks for gross product, average wages and prices, employment, and income. Simulation techniques were used to validate the model and test the performance. The model provides a macroeconometric explanation of the performance of annual levels of output, prices, employment, and income over two decades (1960-1979). Forecasts from this model can be produced utilizing forecasts from national macromodels. Regional econometric models have potential for analyzing impacts of water-related changes on Oregon's agriculture and economy. This research contributes to that eventual accomplishment by developing an econometric model of Oregon's economy. The possible directions for improving and/or extrending this model are also indicated. Various methods for constructing regional models are reviewed with emphasis on tradeoffs between application of economic theory and availability of data. Procedures used and problems encountered in estimating equations of regional econometric models are discussed, as are methods for validating and simulating these models.
W83-03326

THE FLOOD MITIGATION POTENTIAL OF INLAND WETLANDS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
H. Ogawa, and J. W. Male.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-223024, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 138, Massachusetts University, Amherst, March 1983. 164 p, 25 Fig, 19 Tab, 80 Ref. OWRT A-136-MASS(1), 14-34-0001-1123.

Descriptors: *Flood control, *Wetlands, *Watershed protection, Watershed management, Flood recurrence interval, Runoff, Storage capacity, Streamflow, Model studies, Hydrologic models, Simulation, Computer models, *Massachusetts, Non-structural alternatives.

This study investigates evaluation methodologies for the flood mitigation function of inland wetlands, and is intended to provide a tool useful in regulatory decision-making. The simulation methodology employs several publicly available computer models and is applied to data obtained for three eastern Massachusetts watersheds. The models are simulated under three rainfall intensities (10, 100, and 500 year recurrence intervals with 24-hour duration) and three antecedent moisture conditions (dry, moderate, and wet). The wetland encroachment conditions include five levels: 0, 25, 50, 75, and 100%. Because detailed simulation studies are often too time-consuming for wetland regulatory decisions, the simulation results for this study's watersheds are generalized. Analyses show that the effectiveness of a wetland in reducing downstream flooding increases with increases in (1) the area of the wetland, (2) its location downstream, (3) the magnitude of flooding, and (4) the degree of encroachment on the wetland. The wetland's effectiveness decreases with increases in (1) the distance downstream from that wetland and (2) the number and size of other storage areas upstream of damage locations. Regression analyses provided a quick and quantitative assessment of the impacts of wetland encroachment on downstream flooding. However, these results should be used with caution since they are based on regional simulations.
W83-03349

CITIZEN PARTICIPATION IN THE DESIGN AND MANAGEMENT OF RESERVOIRS,
Connor Development Services Ltd., Oakville (Ontario).
D. M. Connor.
Canadian Water Resources Journal, Vol 7, No 2, p 223-237, 1982. 1 Fig, 12 Ref.

Descriptors: *Reservoirs, *Management, *Public participation, Design criteria, Decision making, Planning, Water resources development, Water supply, *Citizen participation, *Canada.

A model of constructive citizen participation is presented along with a set of assumptions, a definition and a process flow chart. To implement the model, several effective operational techniques are outlined: the Social Profile, the Open House, the Citizen Advisory Committee and the use of responsive publications. Cross-cultural applications are also indicated. Since, in many cases, problems with the public are symptoms of internal organizational problems, ten important management considerations are reviewed. These ten include organizational needs determinations, policy review, internal communications, delegation, budgeting, manpower planning, management style, evaluation, program design, and organizational social profile. A strategy for corrective measures is described, including information on profiling, projecting, assessing, and

managing. A case study of hydroelectric development is provided. (Baker-FRC)
W83-03418

MULTI-PURPOSE STORAGE SYSTEMS: OBJECTIVE, CONFLICTS, ALTERNATIVES,
Stanford Univ., CA. Dept. of Operations Research.
N. Buras.
Canadian Water Resources Journal, Vol 7, No 2, p 208-222, 2 Fig, 10 Ref.

Descriptors: *Water storage, *Decision making, *Planning, Reservoirs, Management, Model studies, Multipurpose reservoirs, Water resources development, Mathematical studies, Alternative planning.

Water resources systems are planned to attain a number of objectives or goals, some of which may conflict with one another. The multi-objective approach offers procedures for the generation of non-inferior alternatives and for structured interactions between decision-making and modeling. It was demostrated that mathematical models and operations research techniques are effective instruments for the analysis of objectives and conflicts and for the evaluation of alternative policies relevant to the design, operation and management of multipurpose storage systems. Examples of models relevant to multipurpose water resources systems are reviewed; they enable a clearer representation to be made of the complexities of these systems. A growing body of research is now oriented towards solving multi-objective decision issues, seeking possible trade-offs between conflicting objectives. Three groups of models appear to be particularly appropriate for analyzing the possible effects of multipurpose systems. These are screening models, simulation and sequencing models. The classification is somewhat arbitrary, since design and operation are so closely interactive. (Baker-FRC)
W83-03424

AN ECONOMIC ANALYSIS OF OBSTACLES TO WATER CONSERVATION IN MONTANA WATER LAW,
Montana State Univ., Bozeman. Dept. of Agricultural Economics and Economics.
For primary bibliographic entry see Field 4B.
W83-03464

6B. Evaluation Process

AN ECONOMIC ANALYSIS OF THE DEVILS LAKE BASIN AND PROPOSED LAND USE,
North Dakota State Univ., Fargo. Dept. of Agricultural Economics.
J. A. Leitch, and D. F. Scott.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219741, Price codes: A06 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State University, Fargo, January 1983. 123 p, 16 Fig, 52 Tab, 21 Ref. OWRT B-034-NDAK(3).

Descriptors: *Land use, *Flood damage, Wetland, Drainage, *Flooding, *Surveys, *Snowmelt, Runoff, Balance of Nature, Devils Lake Basin, *Hunting, Employment, Permits, *North Dakota, Social values, Attitudes.

Part I: Two farm operators surveys were conducted in the Devils Lake Basin of North Dakota to collect information on farmer attitudes and dollar losses associated with flooding of agricultural land. A preliminary survey was drawn to assess farm operator attitudes toward wetland, drainage, and flooding; and to identify problem areas relative to collecting information on dollar losses due to flooding. The annual average total dollar loss due to flooding in the entire Basin was estimated to be $1.9 million using long-run price relationships, and $2.9 million using 1974 price relationships. Part II: The type of flooding discussed is a result of spring snowmelt or summer rainfall on relatively flat land with poor natural drainage. This 'sheetwater flooding,' is a problem in the Devils Lake Basin that causes damages to agricultural production. Any plan to reduce flood damages may adversely affect the ecological balance of the region. A planning process was initiated in 1975 to arrive at a solution and public participation has been an important element. Part III: A survey for nonresidents who hunted in North Dakota in 1976 was conducted to obtain information on their expenditures in the state for three main reasons: (1) they had hunted here before, (2) they had friends or relatives in the state, and (3) they were former residents. The estimated total expenditure (excluding license) by all nonresident hunters in 1976 was $2.5 million which resulted in a total of $6.3 million in gross business volume and resulted in direct or nondirect employment of 178 people.
W83-03270

ESTIMATION OF THE ECONOMIC WORTH OF WATER FOR RELEASE DECISIONS,
Oklahoma State Univ., Stillwater. Dept. of Management.
For primary bibliographic entry see Field 6A.
W83-03280

WORTH OF INFLOW FORECAST FOR RESERVOIR OPERATION,
California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 4A.
W83-03296

ECONOMIC IMPACTS OF TRANSFERRING WATER FROM AGRICULTURE TO ALTERNATIVE USES IN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W83-03303

THE COSTS AND BENEFITS OF SOIL EROSION CONTROL IN THE NORTH LAKE CHICOT WATERSHED,
Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 4D.
W83-03331

USE OF HEDONIC PRICE TECHNIQUE TO EVALUATE WETLANDS,
Massachusetts Univ., Amherst. Dept. of Agricultural and Resource Economics.
P. G. Allen, and T. H. Stevens.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222414, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 136, Massachusetts University, Amherst, March 1983. 42 p, 2 Fig, 19 Tab, 19 Ref, 1 Append. OWRT A-134-MASS(1), 14-34-0001-1123.

Descriptors: *Wetlands, *Property values, Real property, Cost-benefit analysis, *Economic rent, *Land appraisals, Regional economics, Tangible benefits, Social values, *Prices, *Massachusetts, *Hedonic price technique, Shoreline value.

The property value technique was used to estimate the economic value of wetlands and open space between residential areas and shorelines for nine areas in Western Massachusetts. In an attempt to control for different neighborhood effects (e.g., distances to schools, central business district, major highway interchanges, and other socioeconomic factors) relatively small and homogeneous tracts were sampled. Analysis using principal components regression showed highly variable results in terms of the location rent due to wetland and wetland adjacent open space. Attempts were made to explain the variability of results by (1) investigation of the sensitivity of the results to function specification, particularly component deletion, (2) analysis of socioeconomic and gross locational differences, and (3) subjective measurement of site attributes based on amenity and visual scoring methods. The principal conclusion was that results are extremely sensitive to model specification. The authors conclude that the property value technique, by itself, may be inappropriate for valuation of nonunique wetland resources.
W83-03343

EXPANSION POTENTIAL FOR IRRIGATION WITHIN THE MISSISSIPPI DELTA REGION,
Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
R. N. Shulstad, R. D. May, J. M. Erstine, B. N. Phillips, and B. E. Herrington, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222430, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 93, Univ. of Arkansas, Fayetteville, March 1983, 55 p, 7 Tab, 2 Fig, 8 Ref, 1 Append. OWRT A-054-ARK(1), 14-34-0001-2104.

Descriptors: *Irrigation, Irrigation wells, *Economic feasibility, *Cost-benefit analysis, Sprinkler-irrigation, Flood irrigation, Furrow irrigation, Land forming, *Arkansas, *Mississippi Delta Region.

17.6 million acres, or 73%, of the Mississippi Delta Region is currently cropland and possesses the physical characteristics of slope, texture and soil type which are recommended for irrigation. Economic feasibility of expanding irrigation by flood, furrow and center pivot methods were examined under 24 scenarios representing two sets of crop prices, yield levels, production costs, opportunity costs and six crop rotations. Irrigation was economically feasible for 56 to 100% of the cropland across all scenarios. Approximately 88% of the cropland can be economically irrigated with flood and furrow in its present form, 8% yield highest net returns if furrow irrigated following land forming and 4% can be economically irrigated only with center pivot systems.
W83-03345

COMPARISON OF RESERVOIRS WITH DISSIMILAR SELECTIVE WITHDRAWAL CAPABILITIES: EFFECTS ON RESERVOIR LIMNOLOGY AND RELEASE WATER QUALITY,
Army Engineer District, Portland, OR.
For primary bibliographic entry see Field 5G.
W83-03422

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

PARAMETRIC STUDY OF SEAWATER REVERSE OSMOSIS DESALTING PLANTS,
Bechtel Group, Inc., San Francisco, CA.
For primary bibliographic entry see Field 3A.
W83-03316

COST AND PRECISION IN A STREAM SAMPLING PROGRAM,
Montana Univ., Missoula. Dept. of Zoology.
A. L. Sheldon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222257, Price codes: A02 in paper copy, A01 in microfiche. Montana Water Resources Research Report No 129, Montana State Univ., Bozeman, May 1983. 16 p, 3 Fig, 1 Tab, 7 Ref. OWRT A-128-MONT(1), 14-34-0001-1128.

Descriptors: *Sampling, *Cost-benefit analysis, Project planning, Benthos, *Fixed costs, *Variable costs, Precision, *Nomograms, Research planning, Lolo Creek, Missoula, *Montana.

Nomograms relating fixed, variable and total costs (time) to sample size and precision are presented for use in research planning. Time costs for a survey of a Montana, USA, stream were dominated by fixed costs and the laboratory component of variable costs while variable field costs were small. Reductions in both fixed and variable costs influence precision of low-budget survey sampling while reduction of variable costs in large-budget research sampling has more effect on total cost than on precision.
W83-03336

TOPICAL QUESTIONS ON CENTRAL CONTROL AND MONITORING FOR WATER SUPPLIES (AKTUELLE FRAGEN BEI ZENTRALER STEUERUNG UND UBERWACHUNG VON WASSERVERSORGUNGEN),
Ingenieurburo Grombach G.m.b.H., Bad Homburg (Germany, F.R.).
For primary bibliographic entry see Field 5F.
W83-03449

6D. Water Demand

A TEST FOR INEQUITY IN RIVER RECREATION RESERVATION SYSTEMS,
North Central Forest Experiment Station, St. Paul, MN.
J. H. Schomaker, and E. C Leatherberry.
Journal of Soil and Water Conservation, Vol 38, No 1, p 52-56, January-February, 1983. 1 Fig, 4 Tab, 5 Ref.

Descriptors: *Recreation demand, *Rivers, Public policy, Reservation, Water management, Water use, Water demand.

The question of whether reservation systems discriminate against certain segments of the population has been addressed. The study draws on data collected from floaters on 26 river stretches not currently subject to reservation systems to determine whether an identifiable group would be placed at a disadvantage if these systems were subject to reservation. The rivers studied vary widely in location and characteristics. Included were remote, western whitewater rivers as well as placid rivers near large population centers in the Northeast. For the rivers studied and the characteristics measured it was concluded that reservation systems for river recreation will not unduly discriminate against an identifiable group. If this fear does exist, however, managers can implement a reservation system that permits some spontaneous trips. On a river where use must be limited, a reservation system seems to be a reasonably fair technique that will be quite readily accepted by the public. A shift in use might occur after implementation of a reservation system, and for this reason a careful study of user characteristics should be made before implementation of such a system and again after it has been implemented. The questionaire developed for the National River Recreation Study is recommended as the tool to be used in monitoring the effect of a reservation system. (Baker-FRC)
W83-03175

EFFICIENT USE OF WATER FOR IRRIGATION IN THE UPPER MIDWEST,
Illinois Univ. at Urbana-Champaign. Water Resources Center.
G. E. Stout, P. N. Walker, W. D. Goetsch, M. D. Thorne, and E. C. Benham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219964, Price codes: A04 in paper copy, A01 in microfiche. Research Report No 176, April 1983. 60 p, 5 Fig, 8 Tab, 10 Ref. OWRT B-120-ILL(6), 14-34-0001-9113.

Descriptors: Alfalfa, Corn, Soybeans, *Irrigation, Water resources, Groundwater, Surface water, *Soil moisture, *Soil moisture models, *Claypan soils, *Drainage, *Economic models, *Water use, North Central U. S., Water demand, Crop yields, Crop response.

The objectives of this multidisciplinary interinstitutional regional study were (1) to determine parameters needed for existing or improved models of crop response; (2) to relate yield response to costs and revenues by assessing the water demand for irrigation; and (3) to study the demand for irrigation, present and projected, and its availability as related to public allocation decisions. From this series of studies it was concluded that: (1) There are many areas of the Midwest with sufficient groundwater and surface water resources to support the development of irrigation. (2) Soil moisture models indicate that only moderate yield response to irrigation can be expected on high moisture soils; on lighter soils and claypan soils, yield response is significant, even in regions with relatively high precipitation. (3) Irrigation and drainage on claypan soils can dramatically increase corn yields. (4) It appears economically worthwhile for the individual farmer operating on moderate soils or on claypan soils to evaluate capital investments in irrigation along with other capital investments. (5) Increases in yields and persistence of alfalfa due to irrigation appear to be insignificant when compared to conventional management practices; further research is needed. A potential, however, appears to exist for improving adaptation of alfalfa varieties to soil water deficits.
W83-03282

IRRIGATION WATER RESPONSE FUNCTION ESTIMATION: AN IMPROVED RIDGE REGRESSION METHODOLOGY,
Montana State Univ., Bozeman. Dept. of Agricultural Economics and Economics.
M. D. Frank, B. R. Beattie, and O. R. Burt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220392, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Montana State Univ., Bozeman, April 1983. 26 p, 3 Fig, 1 Tab, 24 Ref. OWRT B-053-MONT(1), 14-34-0001-0270.

Descriptors: *Water demand, *Production function, *Economic value, *Ridge regression method, Texas, California, *Agricultural use, Southern Texas High Plains, Central California Valley, *Irrigation water.

The long-run viability of irrigated agriculture in many important agricultural regions of the western United States is of major concern. Reliable estimates of water's agricultural use value is fundamental if issues involved in water use efficiency and allocation are to be resolved. This report represents an improved methodology for estimating parameters of agricultural water response models (production functions) from which irrigation water values may be derived. The proposed approach is stochastic-prior-ridge regression with an exact restriction imposed on the sum of the factor elasticities (scale parameter). The procedure is applied with good results to cross-sectional data for the Southern High Plains of Texas and the Central Valley of California.
W83-03302

ECONOMIC IMPACTS OF TRANSFERRING WATER FROM AGRICULTURE TO ALTERNATIVE USES IN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Economics.
R. A. Young.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220400, Price codes: A04 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report No 122, Colorado State University, Fort Collins, April 1983. 55 p, 2 Fig, 2 Tab, 30 Ref. OWRT A-048-COLO(1), 14-34-0001-1106.

Descriptors: *Economic impact, *Water use, *Water costs, *Water demand, Management, *Colorado, Water supply, Water allocation, *Alternative use, Urban water use.

This study is premised on the emergence of two sets of forces which reflect the economics of water allocation in Colorado. The first is the increasingly rapid growth of demands for water in non-agricultural uses. The second premise is that Colorado is passing from the 'expansionary' phase to the 'mature' phase. In the former phase the incremental cost of water remains constant over time, so that new supplies are readily obtainable at reasonable cost. The mature phase, brought on by growth and change in the economy, is characterized by rapidly rising incremental costs and greatly increased interdependencies among water uses and users. In a maturing water economy the high cost of new water brings about a search for water supplies from agricultural uses whose economic value productivity is less than the cost of new water supplies. The study assesses the economic impacts of transferring water from agriculture to urban uses in Colorado.
W83-03303

THE IMPACT OF INSTITUTIONAL STRUCTURE AND CITIZEN PARTICIPATION ON WATER RESOURCE PLANNING IN WESTERN KANSAS,
Kansas Water Resources Research Inst., Manhattan.
J. W. Converse, and T. R. Harris.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222190, Price codes: A04 in paper copy, A01 in microfiche. Contribution No 233, September 1982. 54 p, 1 Fig, 6 Tab, 28 Ref. OWRT B-070-KAN(1), 14-34-0001-1228.

Descriptors: *Citizen participation, Groundwater depletion, Groundwater management district, Water conservation, Farm consolidation, Migration, *Community infrastructure, *Institutional support structure, Agriculture, *Kansas, Ogallala aquifer, *Irrigation, *Crop decisions, Corn, Energy costs, Farm size, Fertilizers, Equipment costs.

The impacts of institutional structure and citizen participation on water resource planning in western Kansas were studied by analysis of census data; by interviews with farmers focusing on their decisions and reasons for decisions; by interviews with others including input suppliers and government agency personnel; and by observation of groundwater management district (GWMD) meetings. Analysis of secondary data suggested that expansion of irrigated acreage may stem or delay outmigration and farm consolidation. Farmers typically viewed water as only one of several important inputs. Cost of pumping rather than actual scarcity was usually the main reason for farm-level efforts to conserve water. Most operations reduced corn acreage between 1978 and 1982, often shifting to irrigated crops requiring less water. The very largest operations were more likely than others to increase corn acreage. GWMDs had a relatively high level of public support. They actively carried out their policies limiting water use as well as promoting voluntary conservation, and they may become increasingly involved in water quality protection in the future. Some difficulty resulted from division of enforcement between the GWMDs and the state Division of Water Resources. Some ambiguities in the relation between irrigated agriculture and the vitality of community infrastructure are discussed.
W83-03330

USE OF WATER IN ARKANSAS, 1980,
Arkansas Geological Commission, Little Rock.
T. W. Holland, and A. H. Ludwig.
Arkansas Geological Commission Water Resources Summary 14, 1981. 30 p, 4 Fig, 10 Tab, 14 Ref.

Descriptors: *Water use, *Groundwater, *Surface water, *Water demand, Aquifers, Reservoirs, Consumptive use, Irrigation, Electric power production, Fish farming, Municipal water, Domestic water, Industrial water, Thermal powerplants, Water supply, Arkansas.

This report summarizes the results of the 1980 Arkansas water-use inventory. Water-use data for the following catagories is public supply, 263 million gallons per day; self-supplied industry, 235 million gallons per day; rural domestic and livestock, 118 million gallons per day; irrigation, 4,082 million gallons per day; fish and minnow farms, 415 million gallons per day; wildlife impoundments, 139 million gallons per day; and electric-energy generation 35,461 million gallons per day. These data are tabulated by county, by hydrologic unit, and by source. Water withdrawals during 1980 were 40,714 million gallons per day, of which ground water provided 4,056 million gallons per day, and surface-water sources supplied 36,658 million gallons per day. The largest use of water was for electric-energy generation, which accounted for 87% of the total withdrawals. Excluding hydroelectric diversions, 1980 surface-water use was

1,200 million gallons per day, and 1980 groundwater use was 4,053 million gallons per day. Nine % (3,599 million gallons per day) of the total was consumed. (USGS)
W83-03367

A PUBLIC PARTICIPATION DECISION TO FILL A PACIFIC NORTHWEST RESERVOIR,
Army Engineer District, Portland, OR.
R. A. Cassidy, and E. B. Johnson.
Canadian Water Resources Journal, Vol 7, No 2, p 305-314, 1982. 2 Fig, 4 Ref.

Descriptors: *Reservoir, *Public participation, Planning, *Decision making, Water management, Water resources development, Social participation, Construction, Dam construction, Dams, Water supply, *Oregon, Lost Creek Dam.

The United States Army Corps of Engineers constructed a 105 meter long multipurpose dam, Lost Creek Dam, in the Rogue River Basin, Oregon. Construction was completed during a drought in mid-October 1976, but the decision to begin filling was delayed until late January 1977. Closure of the diversion tunnel to impound water during the drought was opposed by numerous federal, state and local officials because of the danger to the $20 million per year anadromous fishery of national acclaim downstream of the dam. Although the Corps withdrew its decision to close the tunnel and impound water, a local Chamber of Commerce requested that the social and economic effects be considered. Following three weeks of public participation, most of the people that originally opposed closure changed their position. The diversion tunnel was closed and the dam began impounding water on February 18, 1977. Earlier closure of the diversion tunnel to start filling the reservoir would have been more beneficial to the multiple water resources needs of the Rogue River. The public decision to close the project was based on a balanced evaluation of the multiple purpose needs of fisheries, irrigation, hydroelectric power and recreation in the Rogue River Basin. (Baker-FRC)
W83-03423

MULTIPURPOSE USE OF AN EUTROPHIC SOUTH AFRICAN MAN-MADE RESERVOIR,
Hydrological Research Inst., Pretoria (South Africa).
C. A. Bruwer.
Canadian Water Resources Journal, Vol 7, No 2, p 238-254, 1982. 1 Fig, 5 Tab, 14 Ref.

Descriptors: *Reservoirs, Water resources development, *Management, Decision making, Planning, Fisheries, Recreation, Water quality, Eutrophication, Nutrients, Stratification, Potable water, Water supply, *South Africa, Hartbeespoort Dam.

Hartbeespoort Dam lies in close proximity to two major population centers in South Africa. It was constructed in 1925 with the sole purpose of irrigation water supply. Through the years multipurpose use demands such as recreational, conservational, land use along the shores and flood control developed extensively. In order to put the multiple use demands on the reservoir into perspective it is important to follow the changes in water quality of the reservoir from the time of construction to recent times. Essentially the Dam may be described as an eutrophic, shallow, warm, stratified, monomictic lake with winter overturn occurring during May each year and summer stratification occurring from September to April. Main sources of nutrients to the reservoir are secondary treated sewage effluent from the city of Johannesburg and nitrogen-rich effluents from industries discharged into the Crocodile River. Current management procedures have been developed through the years in isolation by each agency which had a responsibility towards a certain aspect of the reservoir. Local government through a number of autonomous agencies controls fisheries and recreation on the reservoir, treats raw water to potable standards, and discharges secondary treated sewage and industrial effluents to the reservoir. All agencies are being called upon to define predetermined goals to be achieved by management. (Baker-FRC)
W83-03425

FACTORS INFLUENCING HOURLY AND DAILY WATER DEMAND (UBER DIE STUNDEN-UND TAGEWASSERBEDARF BEEINFLUSSENDEN FAKTOREN),
Wroclaw Technical Univ. (Poland). Inst. of Environmental Engineering.
Z. Siwon, and J. Ciezak.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 8, p 364-368, 1981. 3 Fig, 4 Tab, 9 Ref. English Abstract.

Descriptors: *Correlation analysis, *Regression analysis, *Water use, *Consumptive use, *Forecasting, Projections, Water management, Resources management, mathematical studies Statistical analysis, *Water demand.

The correlation between daily and hourly water consumption, as well as some factors affecting this correlation, were studied. A short-range forecasting of the daily and hourly water demand over a period of one to three days can be carried out using multiple regression equations which incorporate the following parameters: the weekly cycle of water consumption, meteoroligical factors, the quantity of water consumed the day before, and the quantity consumed two to three days before. The coefficients in the regression equations can be calculated from the quantities of water consumption observed a year before and in January of the year for which the forecast is being made. (Author's abstract)
W83-03438

TECHNOLOGY ASSESSMENT OF IRRIGATION SCHEDULING AND CROP RESPONSE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W83-03488

WATER-ITS ROLE FROM NOW TO THE YEAR 2000,
Texas Univ. at Austin.
E. T. Smerdon.
Natural Resources Journal, Vol 22, No 4, p 907-914, October, 1982. 9 Ref.

Descriptors: *Water management, *Crop production, *Energy, *Mexico, *United States, Resources management, Water requirements, Water supply, Water quality.

Mexico-US transboundary resource needs and issues are discussed, with emphasis on the relationships between water and food and water and energy. Sufficient water is key to producing the food needed by mankind. While water is the key to productivity, it is also a limiting factor. Water will be needed in the US to develop and transport alternate energy sources. Adequate analysis has not been made of the impact of diverting water from agricultural uses to energy uses. The sociological and economic impacts of a shift in water use must be examined. Future water needs must be assessed carefully to ensure that future food and energy needs can be met. (Small-FRC)
W83-03491

WATER AVAILABILITY IN THE NEW MEXICO UPPER RIO GRANDE BASIN TO THE YEAR 2000,
New Mexico Univ., Albuquerque. Bureau of Business and Economic Research.
B. McDonald, and J. Tysseling.
Natural Recources Journal, Vol 22, No 4, p 855-876, October, 1982. 2 Fig, 10 Tab.

Descriptors: *Available water, *Water requirements, *Rio Grande, *Water use, *Forecasting, Water supply, Water demand, Domestic water, Agriculture, *New Mexico, Population dynamics, Rivers.

The present and future water demand and supply for the New Mexico Upper Rio Grande Basin was analyzed. Present water use within the region was determined, and the factors which restrict the water supply were examined. Population and economic activity within the region were projected to the year 2000 and were used to establish future non-agricultural water demand. A total increase in water use of 78,167 acre-feet was projected. Agricultural has not increased over the past ten years, so no increase was expected for the future. The largest increase (47,737 acre-feet) was in the domestic water use category due to population increases. Water supply was judged to be sufficient to meet the projected demand. Thus, water should not be a constraint on the economic growth of this region. The San Juan-Chama project water will make this sufficient water supply possible. (Small-FRC)
W83-03493

ANTICIPATING TRANSBOUNDARY WATER NEEDS AND ISSUES IN THE MEXICO-UNITED STATES BORDER REGION IN THE RIO GRANDE BASIN,
Texas Univ. at Austin. Center for Research in Water Resources.
N. E. Armstrong.
Natural Resources Journal, Vol 22, No 4, p 877-906, October, 1982. 6 Fig, 5 Tab.

Descriptors: *Water requirements, *Water supply, *Rio Grande, *Texas, *Mexico, Reservoirs, Water management, Water quality, Water quality managment, Urbanization, Population dynamics, Surface water, International agreements.

The present surface and groundwater available in the Rio Grande Basin in the Texas-Mexico border area is described, and water needs for the basin are forecast. Also, water-related issues in the transboundary area are identified. Resources include various streams and reservoirs, as well as the following Texas aquifers: El Paso, Salt Basin, Pecos Valley, Plateau, Carrizo-Wilcox, and Gulf Coast. City populations are expected to double in the next 30 years, causing increases in water demand. Total withdrawals from the Rio Grande are expected to decrease 11% by the year 2000 because of a 14% decrease in agricultural water use. Domestic use and manufacturing use are expected to increase. Water supply problems in the El Paso-Juarez area include surface water supply and water quuality degradation. The lower Rio Grande Valley may not have enough water to supply growing industries, while in the Pecos Valley deterioration of water quality due to natural brine emissions is a problem. Treaties between the US and Mexico control transboundary waters. (Small-FRC)
W83-03495

6E. Water Law and Institutions

WATER INDUSTRY ACCOUNTABILITY THROUGH THE OMBUDSMAN SYSTEM,
Birmingham Univ. (England).
M. J. Harley, and M. Hobson.
Water Services, Vol 86, No 1032, p 59-61, February, 1982. 5 Tab.

Descriptors: *Metropolitan water management, *Administration, Adjudication procedure, Utilities, *United Kingdom.

The United Kingdom has established several offices, institutions, and procedures for reviewing the administrative actions of public bodies during the period since 1967. The Parliamentary Commissioner for Administration (PCA) and the Commissions for Local Administration in England and Wales are the three offices having most jurisdiction over administrative acts of public bodies constituting the water industry. The Commissions for Local Administration for England and for Wales are responsible for handling complaints of alleged injustice through maladministration by water authorities and by statutory water companies in their capacities as agents of the water authorities. The lengthy complaint procedure used by the Local Commissions includes filing a complaint with the relevant authority and waiting for a response, filing a complaint with a member of the authority and waiting for that member to file the complaint with the Commission, and then direct filing with the Commission if the member fails to resolve the problem or to file with the Commission. The Local Com-

missions have issued 35 reports in cases in which at least one water authority was investigated, and there have been findings of maladministration by the water authority in 16 of these cases. Water supply and resources activities accounted for 40 percent of these investigations, while sewerage and sewage disposal accounted for 34 percent and land or field drainage issues accounted for 14 percent of the cases. (Carroll-FRC)
W83-03233

THE EVOLUTION OF CALIFORNIA STATE WATER PLANNING 1850-1928,
California Univ., Davis. Dept. of History.
W. T. Jackson, and D. J. Pisani.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-219782, Price codes: A14 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, University of California, Davis, May 1983. 302 p, 594 Ref. OWRT A-075-CAL(1).

Descriptors: *History, *Irrigation, *California, Political aspects, *Planning, *Water policy, *State jurisdiction, Federal jurisdiction, Water supply development, Water rights, Legal aspects, Riparian rights, Appropriation, Water conveyance, Water supply systems, Public policy, Water rates, Water resources development.

This is a study of the evolution of irrigation, water law, and water resource planning in California from statehood until 1930, the year in which the first comprehensive state water plan was submitted to the legislature. It was designed to fill an important gap in the historical record. There is no comprehensive history of the development of water resources in California, or the arid West as a whole. Other topics considered included the evolution of 'court-made' water law; the conflict between federal and state reclamation at the turn of the 20th century; the development of the 'multiple-use' concept of water planning; and the evolution of the first state water plan. Our research has led to several conclusions. First, the development of a state water plan was much more than a scientific quest to promate agricultural efficiency, or even provide the 'greatest good for the greatest number.' For the controversies surrounding the state's role in water development invariably reflected broader political, economic, and social trends. Ultimately water policies were shaped as much by a vision of what California should or could become as by the more limited objectives of farmers. The state's failure to play a more active part in stimulating irrigation during the 19th century was not due to a laissez-faire philosophy of government, or even the assumption that the job was best done by private enterprise, but fear that any large-scale state expenditures would strengthen monopolies. Finally, the lawmakers came to realize that California was too fragmented into sections and special interests to achieve a coordinated, unified water plan.
W83-03274

A MANUAL FOR DEVELOPING SMALL-SCALE AND MICRO-HYDROPOWER PLANTS IN IDAHO - A GUIDE TO PERMITS, LICENSES, AND INCENTIVES,
Idaho Univ., Moscow. Dept. of Civil Engineering.
C. C. Warnick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-221739. Price codes: A06 in paper copy, A01 in microfiche. Idaho Water and Energy Research Institute Completion Report, Moscow, April 1983. 107 p, 31 Fig, 6 Tab, 33 Ref, 1 Append. OWRT A-079-IDA(1). 14-34-0001-2114.

Descriptors: *Hydroelectric power, Hydraulic turbines, *Hydroelectric project licensing, Electric power, Federal Power Act, *Idaho, Evaluation assessment, Economic evaluation.

This manual has been prepared to assist potential developers of hydropower and to help agency personnel concerned with hydropower, planning and development in Idaho. It is designed to guide the developer through the various steps in preparing a feasibility study and completing the necessary licensing. The manual gives brief information on the engineering requirements and the economic analysis and references as to how to obtain necessary professional assistance. Necessary steps and actions that must be taken to obtain appropriate permits, licenses and compliance certification have been presented in sections involving local permitting, State law requirements, and Federal law requirements. This includes graphic flow charts, expected time requirements, and specific information on addresses and phone numbers to make necessary contacts. A brief discussion is presented on incentives for developing small-scale hydropower in Idaho, with information on financing possibiliies and requirements for developing power sales contracts. A very specific set of references for use of those working in Idaho is included. The manual includes in the Appendix a glossary and a list of hydroelectric turbine manufacturers.
W83-03320

FLOOD LOSS REDUCTION THROUGH INTERSTATE COMPACTS: AN UNDER-UTILIZED APPROACH,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
For primary bibliographic entry see Field 6F.
W83-03324

THE ESCATAWPA RIVER - AN INTERSTATE APPROACH TO WATER RESOURCE MANAGEMENT,
Mississippi Univ. Law Center, University.
A. L. Sage, III, and M. T. Gibbs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224188, Price codes: A04 in paper copy, A01 in microfiche. Mississippi Water Resources Research Institute, Mississippi State, Completion Report, July 1982, 46 p. OWRT A-135-MS(1), 14-34-0001-1126.

Descriptors: *Water law, *Equitable apportionment appropriation, Riparian rights, *Interstate rivers, *Alabama, *Mississippi, Mass allocation, Mobile, *Escatawpa River, *Interstate compacts, Municipal water, California doctrine, Alternative supply, Reasonable use, Natural flow doctrine, Prescriptive rights, Big Creek(Alabama/Mississippi), Statutory appropriation.

The purpose of this study was to analyze the legal position of the states of Mississippi and Alabama in a conflict concerning the use of water from an interstate stream in the City of Mobile's municipal water supply. The report does not include an analysis of the legal positions of private individuals of Mobile except as they pertain to the legal positions of the states. Although the two states have legal systems that apply different rules to disputes over water rights the decisions of the United States Supreme Court do not indicate that either state's law would be the deciding factor in a dispute over the use of the stream in question. The rule applied by the Supreme Court is called the Doctrine of Equitable Apportionment and in essence holds that states have equal rights in an interstate stream. However, this does not mean the water is equally divided, but that a solution fair and equitable to both is sought by balancing the harm and benefits to both states if particular actions are taken. The report discusses in detail the factors previously used in achieving balancing of equities. Concluding that the expense, complexity and uncertainty of results are prohibitive in a Supreme Court suit, the report recommends negotiation of an interstate compact between Alabama and Mississipi. Provisions necessary to the successful working of a compact are discussed.
W83-03354

ADAPTING APPROPRIATION WATER LAW TO ACCOMMODATE EQUITABLE CONSIDERATION OF INSTREAM FLOW USES,
Utah Water Research Lab., Logan.
J. M. Bagley, D. T. Larson, and L. Kapaloski.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224394, Price codes: A06 in paper copy, A01 in microfiche. Utah Water Research Laboratory Completion Report, June 1983. 118 p, 4 Fig, 3 Tab, 26 Ref. OWRT B-189-UTAH(1), 14-34-0001-0279.

Descriptors: *Appropriation, *Water law, *Water rights, Legal aspects, *Instream flow, Environmental protection, Environmental quality, Aesthetics, Diversion, Water loss, Recreation, *Western U.S.

The increasing public interest in naturally flowing streams has fostered efforts to obtain their protection under existing state water laws. In this study, the water laws of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming were examined and compared (1) with each other, and (2) against a set of salient criteria, to assess shortcomings in accommodating instream flow protections. It was determined that appropriation system has the essential features of and embodies legal principles that should allow the accommodation of instream flow values but, at this point in time, purchase of existing rights or the exercise of governmental reservation/withdrawal/appropriation authorities seem to be the primary options. Legislative, judicial, and administrative strategies for protecting instream flows apart from the normal appropriation process were reviewed. Certain legislative and administrative strategies hold premise as supplementary to the standard appropriation procedure. Likewise, private sector strategies utilizing contracts, easements, purchase of development rights, etc. need to be more thoroughly considered. Where instream flow protections do not justify preemptive rights and strategies, and if hydrologic imperatives are properly observed, the state administered appropriation systems can accommodate the instream flow need. However, the need for better technical information for establishing beneficial need for the many instream values, and for use in projecting the biologic-hydrologic consequences of particular instream flow regimes remains a stumbling block to the accommodation process.
W83-03379

THE MEANING OF THE GENERALLY ACCEPTED TECHNOLOGICAL STANDARDS FOR THE PLANNING, CONSTRUCTION, AND OPERATION OF WATER DISTRIBUTION FACILITIES (DIE BEDEUTUNG DER ANERKANNTEN REGELN DER TECHNIK FUR PLANUNG, BAU UND BETRIEB VON WASSERVERSORGUNGSANLAGEN),
Deutscher Verein des Gas- und Wasserfaches e.V., Eschborn (Germany, F.R.).
W. Merkel.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 3, p 105-111, March, 1981. 13 Ref. English abstract.

Descriptors: *Water law, *Water distribution, *Standards, *Construction, *Operating policies, Domestic water, Design standards, Legal aspects, *Federal Republic of Germany, Water policy, Safety, Construction materials.

Water law in most of the states of the Federal Republic of Germany requires the observation of the 'generally recognized technological standards' in the construction, operation, and maintenance of water distribution facilities. Domestic water installations are subject to the same requirements according to federal law. These laws were designed to assure public safety and act as a buffer between professionals and the public. 'Generally recognized technological standards' are interpreted in federal law as principles and solutions that have been implemented by those practicing in the appropriate field of technology -- practical proof of the standard's validity is required, while acceptance in the scientific literature alone is inadequate. The generally recognized standards are not usually part of the law itself but are recommendations. An exception to this is the incorporation (or fixed reference in a law) of the text of a technological standard into a law; this has the disadvantage of requiring a change in the law to effect a change in the standard -- the dynamic nature of technology is ignored. The sliding reference (making the standard binding in its current form) is usually dismissed as unconstitutional, because the legislator has thereby delegated his authority to the standard-defining group over which he has no control. (Gish-FRC)
W83-03441

DEVELOPMENT AND STATUS OF EMERGENCY DRINKING WATER SUPPLY IN THE FEDERAL REPUBLIC OF GERMANY AFTER PASSAGE OF THE WATER SAFEGUARDING LAW (ENTWICKLUNG UND STAND DER TINKWASSER-NOTVERSORGUNG IN DER BUNDESREPUBLIK NACH DEM WASSERSICHERSTELLUNGSGESETZ),
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
For primary bibliographic entry see Field 5F.
W83-03458

EFFECTS OF WILDERNESS LEGISLATION ON WATER PROJECT DEVELOPMENT IN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Economics.
For primary bibliographic entry see Field 6G.
W83-03489

NEW MEXICO WATER LAW: AN OVERVIEW AND DISCUSSION OF CURRENT ISSUES,
New Mexico Univ., Albuquerque.
C. T. DuMars.
Natural Resources Journal, Vol 22, No 4, p 1045-1064, October, 1982. 7 Fig, 64 Ref.

Descriptors: *Water rights, *Appropriation, *Water management, Water allocation, Water permits, Water policy, Water law, Groundwater management, Jurisdiction, Termits, Political constraints, Institutional constraints, *New Mexico, Legal aspects, Reservation doctrine, State jurisdiction, Beneficial use.

New Mexico's water law is based on the prior appropriation system. The hydrological relationship between groundwater and surface water is acknowledged. All water resources are public property, but water rights may be acquired by individuals for beneficial use. The State Engineer is charged with administration of matters relating to appropriation, transfer, and distribution of water. Current declared underground water basins cover 73,546 sq miles of the state. Groundwater rights can be sold or transferred with respect to location and purpose. Limited transfers from surface to grondwater appropriations have also been allowed. Other agencies involved with administration of water rights include the Interstate Stream Commission and local conservancy districts. Problems facing water management in this state are: (1) interstate competition for groundwater from states that have no clearly defined groundwater mangement policy, (2) uncertainty created by unquantified Indian federal reserved water rights, and (3) the dilemma posed by the duty to protect capital investments in a means of groundwater diversion while promoting maximum utilization of water resources for present and future generations. (Cassar-FRC)
W83-03492

OVERVIEW OF GROUNDWATER LAW AND INSTITUTIONS IN UNITED STATES BORDER STATES,
Arizona Univ., Tucson. School of Law.
R. E. Clark.
Natural Resources Journal, Vol 22, No 4, p 1007-1015, October, 1982. 21 Ref.

Descriptors: *Water law, *Groundwater management, *State jurisdiction, *Legal aspects, Common law, Equitable apportionment, International law, Public rights, Regulations, Jurisdiction, Water rights, Texas, Arizona, New Mexico, California, Mexico, Groundwater.

Issues surrounding US border groundwater law are discussed, and interstate friction between border states and Mexico over groundwater withdrawals and transportation across state lines is considered. Texas, Arizona, and California follow common law property rules, while New Mexico water law is based on appropriation. Texas law permits unlimited groundwater withdrawals, while California relates the volume of groundwater withdrawn to overlying surface owenership or use. New Mexico has a statewide permit system; the resource is public until acquired. New Mexico was one of the first states to establish a groundwater management system. Arizona has a state administered system where there are controls over specific types of uses. Formal international cooperation between the US and Mexico is suggested to control border water supply and water quality. (Small-FRC)
W83-03496

TEXAS GROUNDWATER LAW: A SURVEY AND SOME PROPOSALS,
Texas Univ. at Austin. School of Law.
C. W. Johnson.
Natural Resources Journal, Vol 22, No 4, p 1017-1030, October, 1982. 41 Ref.

Descriptors: *Water law, *Texas, *Groundwater pollution, *Groundwater management, *Aquifers, Legal aspects, Water pollution, Water management, Groundwater, Judicial decisions, Common law, Regulations, Water rights, Drilling.

Groundwater law in Texas is surveyed, major weaknesses are made. The state legislature has not changed the common law of groundwater allocation as applied by the courts. Only in a few instances, such as recharge of aquifers, has the legislature addressed groundwater problems directly or authorized a state agency to do so. It has been active in protecting groundwater from pollution from a variety of activities including improper drilling of water wells; activitie associated with the development of oil, gas, other minerals, and geothermal resources; and disposal of wastes in dumps or underground. Local governments have a significant role in groundwater management. Problems in Texas include the virtual absence of law for resolving conflicts among pumpers, lack of coordination of groundwater and surface water rights, and absence of laws to prevent depletion of aquifers. (Small-FRC)
W83-03497

CALIFORNIA GROUNDWATER MANAGEMENT: THE SACRED AND THE PROFANE,
John Muir Inst., Berkeley, CA. Center for National Resource Studies.
G. Weatherford, K. Malcolm, and B. Andrews.
Natural Resources Journal, Vol 22, No 4, p 1031-1043, October, 1982. 49 Ref.

Descriptors: *Groundwater management, *Legal aspects, *Water rights, *Water supply, *California, Water shortages, Water law, Groundwater mining, Groundwater depletion, Subsidence, Aquifers, Groundwater recharge, Artificial recharge.

California pumps more groundwater than any other state in the union, yet it lacks a coordinated statewide managment program for the resource. California relies on an annual developed water supply of 42 million acre feet (MAF), of which about 15 MAF is pumped groundwater. Misuse of groundwater has caused problems, including threatened depletion is some areas, seawater intrusion, contamination by toxic compounds, and land subsidence. There is no coherent or comprehensive groundwater law or policy. Groundwater rights are defined by court-made law, and the regulation of groundwater occurs selectively in some water districts. Groundwater rights law involves correlative rights, appropriative rights, mutual prescription, and notions of equitable apportionment. Recharging of aquifers with imported water has been one way California has dealt with water supply problems. (Small-FRC)
W83-03498

6F. Nonstructural Alternatives

FLOOD LOSS REDUCTION THROUGH INTERSTATE COMPACTS: AN UNDER-UTILIZED APPROACH,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
R. H. Platt, and W. Nechamen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-221770, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 137, Massachusetts University, Amherst, March 1983. 146 p, 4 Fig, 6 Tab, 40 Ref, 3 Append. OWRT A-137-MASS(1), 14-34-0001-1123.

Descriptors: *Flood control, *Interstate compacts, *Interstate rivers, *Water law, *Non-structural alternatives, Water management, Planning, Political aspects, Delaware River, Connecticut River.

The federal government has long wrestled with the conflicting priorities of state and federal jurisdiction. While federal authority over waterways has historically increased, states still maintain considerable jurisdictional prerogatives over land use and non-interstate water projects. However, local waterways often flow into larger streams whic gather water from portions of several states. In recent years, a 'partnership' policy between federal and nonfederal jurisdictions has grown as a preferred option necessitating increased interstate planning and cooperation: a difficult task to achieve when priorities conflict. Interstate compacts, which are essentially treaties between states, have been extensively utilized since the 1920's to allocate water in the Western States. In the East, compacts have been developed for pollution control and flood control, as well as for allocation. A limited flood control compact in the Connecticut River Basin and an extensive multipurpose federal-interstate compact in the Delaware River Basin are devices which could be used to mitigate interstate flooding problems. However, the Connecticut compact has never been effective beyond the narrow purpose of tax loss reimbursements. The Delaware compact could be more effective in the area of flood control. In both cases, only increased public awareness and perception of flood hazard are likely to effect greater utilization of existing compacts.
W83-03324

6G. Ecologic Impact Of Water Development

A 'BEFORE AND AFTER' STUDY OF THE EFFECTS OF LAND DRAINAGE WORKS ON FISH STOCKS IN THE UPPER REACHES OF A LOWLAND RIVER,
Liverpool Univ. (England).
S. Swales.
Fisheries Management, Vol 13, No 3, p 105-114, July, 1982. 5 Fig, 3 Tab, 31 Ref.

Descriptors: *Environmental effects, *Fish populations, *Channel improvement, Drainage effects, Soar River, *United Kingdom, Aquatic habitats, Habitats, Vegetation.

Fish populations were markedly changed in the upstream reaches of the River Soar, Leicestershire, after river channel works improved land drainage. The study site was a 100 m slow-flowing reach 1 m deep, with shallow riffles at its upstream and downstream limits and abundant bankside trees and vegetation. The drainage scheme consisted of river dredging and widening and vegetation clearance, designed to reduce flooding on 360 ha of agricultural land. Although water quality parameters, flow conditions, add bottom substrate before (5/5/77) and after (3/15/79) channel works were not different, there was a marked decrease in instream cover. Mean densities of fish $>$ 10 cm long were 0.160 per sq m before and 0.048 per sq m after the project. The mean standing crop of fish was 39.0 g per sq m before and 9.6 g per sq m after the project. Reductions in standing crop were: brown trout, 100%; chub, 81%; dace, 72%; and roach, 15%. (Cassar-FRC)
W83-03192

FISHERIES PRODUCTIVITY AND WATER LEVEL FLUCTUATIONS IN LAC SEUL, NORTHWESTERN ONTARIO,
Hanna (J.E.) Associates, Inc., Mississauga (Ontario).
J. E. Hanna, and M. F. P. Michalski.
Canadian Water Resources Journal, Vol 7, No 2, p 365, 388, 1982. 4 Fig, 9 Tab, 8 Ref.

Descriptors: *Reservoirs, *Water resources development. *Fisheries, *Ontario, Canada, Lac Seul, English River, Watersheds, Management, Water management, Planning, Decision making.

Lac Seul, located in the English River watershed in nothwestern Ontario, has been regulated for power production since 1935. The lake supports a sports and commercial fishery, with yellow pickerel, northern pike, lake whitefish, tullibee, and coarse fish dominating the harvest. Commercial harvest records date to 1924, and sports anglers' catches have been sampled on several occasions since 1960. An in-depth analysis of water levels and fisheries productivity revealed a number of relationships. First, significant increases in the yields of yellow pickerel and northern pike were associated with the initial flooding. Second, changes in water level regulation patterns appear to have had short term negative impacts on productivity. However, the fishery has adapted to the new regimes with little long term effect. Third, correlations between annual fish yields and minimum spring water levels as well as seasonal water level variations suggest a threshold response of the fishery, below which water level changes have had little or no effect. The implications of these results for reservoir design and management are considered. (Baker-FRC)
W83-03212

ASSESSING ENVIROMENTAL IMPACTS OF OPEN WATER DISPOSAL OF DREDGED SEDIMENT,
Colorado State Univ., Fort Collins.
G. F. Lee, and R. A. Jones.
World Dredging and Marine Construction, Vol 18, No 4, p 20-22, April, 1982. 6 Ref.

Descriptors: *Dredging, *Spoil disposal, *Bottom sediments, Water pollution effects, Measurement techniques, Environmental effects, Bioassay, Water quality standards.

Since 1970, significant research has been conducted to determine the effects of contaminants in dredged material on water quality and to investigate the environmental effects of dredged sediment disposal. Environmental effects of disposal of this material include both the physical impact of deposition of solid material on aquatic organisms in the area and the impact of the chemical contaminants associated with the sediments. Although research results have demonstrated that the total concentration of a contaminant in dredged material is not a reliable indicator of potential water quality problems associated with disposal of the sediment, some pollution control agencies still regulated dredging practice using bulk sediment criteria to evaluate the potential environmental impact of disposal of the material and to make decisions regarding the disposal method to be used. The U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers have developed the elutriate test and benthic organism bioassay test procedures as a substitute for bulk sediment criteria. However, the elutriate test grossly overestimates the amount of contaminant release that will occur when mechanically dredged sediments are dumped in open waters and is not a suitable tool for predicting the contaminant release in the overflow waters associated with areas of confined disposal. In addition, the bioassay procedures are not used as often as they should be in the formulation of disposal practices because they are too complex and excessively costly and because there are no guidelines for interpreting results. It is recommended that a bioassay screening test using only one type of organism be used to detect potential toxicity problems. The authors suggest that a site-specific hazard assessment, conducted to evaluate the potential environmental impact of open water disposal of dredged sediments, would lead to a more technically valid, cost-effective, and at least equally environmentally protective approach as that currently used. (Carroll-FRC)
W83-03251

THE EFFECTS OF ALTERED HYDROLOGIC REGIME ON TREE GROWTH ALONG THE MISSOURI RIVER IN NORTH DAKOTA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
P. W. Reily, and W. C. Johnson.
Canadian Journal of Botany, Vol 60, No 11, p 2410-2423, 1982. 11 Fig, 7 Tab, 34 Ref. OWRT B-108-VA.

Descriptors: *Dam effects, *Regression analysis, *Growth kinetics, *Trees, *Flood plains, *Water table decline, Environmental effects, Ecological effects, Growth rates, Oak trees, Cottonwood trees, Elm trees, Flow pattern, *North Dakota, Missouri River, Garrison Dam.

Tree growth increment cores were examined and related to changes in the hydrologic regime of the floodplain downstream of Garrison Dam on the Missouri River by multiple regression analysis. Cumulative growth of trees was also compared during two 20-year periods to determine predam and postdam growth patterns. Results showed significant decline in the postdam growth of Ulmus americana, Fraxinus pennsylvanica, Acer negundo, and Quercus macrocarpa due to alterations in seasonal streamflow patterns, near elimination of over-bank flooding, and apparent lowering of the water table during the early growing season following completion of the dam in 1953. Measured decline in growth of Populus deltoides was not statistically significant. The least affected trees were those on terraces at the edge of the floodplain receiving concentrated runoff from upland ravines and those with deep root systems on low terraces close to the water table. On high terraces that received little upland runoff, trees showed the most pronounced decreases in growth. Radial growth of P. deltoides showed a distinct change from correlation with spring streamflow in the predam period to correlation with rainfall parameters in the postdam period. On reference sites unaffected by the Garrison Dam, growth of P. deltoides and Q. macrocarpa increased significantly in the postdam period. (Geiger-FRC)
W83-03262

EVALUATION AND MONITORING OF THE HYDROLOGIC IMPACT OF CABIN CREEK, B.C. COAL PIT MINING ON THE NORTH FORK OF THE FLATHEAD RIVER,
Montana Univ., Missoula. Dept. of Geology.
C. Dalby.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-221788. Price codes: A09 in paper copy, A01 in microfiche. Montana Water Resources Research report no. 130, Montana State Univ., Bozeman, March 1983. 172p, 23 Tab, 31 Fig, 141 Ref. OWRT A-096-MONT(1); A-101-MONT(1). 14-34-0001-6027,7055,7056.

Descriptors: *Coal mines, *Sediment yield, *Sediment transport, *Geomorphology, Erosion, Water quality, Reclamation, Fluvial sediments, Channel mapping, Gravel-bed river, North Fork Flathead River, Cabin Creek, Glacier National Park, Montana, Canada, *British Columbia.

The North Fork of the Flathead River forms the northwestern boundary of Glacier National Park in Montana and originates in the province of British Columbia. Sage Creek Coal Ltd. plans to develop metallurgical grad coal deposits contained in two large hills, one on either side of Cabin Creek, a tributary of the North Fork located 8 miles north of the Canadian border. The climate of the area, steepness of terrain, composition of overburden, and contour-strip style of mining, indicate a high potential for erosion and sediment production. Introduction of coarse bed-material sediment into the North Fork as the result of mining could alter downstream channel processes and the shape of the channel. The fluvial geomorphology of the channel extending from the Canadian border to the Middle Fork Flathead River was mapped and classified at 1:24,000 scale. The analysis shows that the North Fork is similar to other gravel bed rivers and provides a basis for estimating the effect of increased sediment loads on channel morphology. The total sediment yield at the Cabin Creek mine site was estimated to be about 1.2 million tons over the 21-year mine life. A 50% reduction in this yield, through partly successful reclamation, would still allow the contribution of about 60,000 tons per year to the North Fork's annual total load of the North Fork at the Canadian border. An increase of this magnitude would significantly affect downstream water quality, channel processes, and morphology. Recommendations for a sediment monitoring program are given.
W83-03325

AGRICULTURAL STREAM ECOSYSTEMS: STRUCTURE AND FUNCTION FOR UNDERSTANDING WATER QUALITY IMPROVEMENTS,
Iowa State Univ., Ames. Dept. of Animal Ecology.
J. B. Barnum, and R. W. Bachmann.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224261, Price codes: A06 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute Publication No 124, March 1983. 113 p, 22 Fig, 37 Tab, 49 Ref. OWRT A-079-IA(1), 14-34-001-0017.

Descriptors: *Agricultural watersheds, *Decomposition, *Primary production, Water quality, *Invertebrates, Streams, Riparian, Vegetation, *Land use, Impacts, Phosphorus, Chlorophyll a, Suspended solids, Nitrogen.

Twelve emphemeral to perennial stream sites within eight agricultural watersheds were studied in order to define key ecological processes regarding in-stream functional adjustments to agricultural watershed impacts. The ecological processes or indices investigated were detrital decomposition, primary production, invertebrate community structure, water quality and analyses of watershed land use practices. The drainages were differentially impacted by intensive row crop development, grazing, removal of riparian vegetation, channelization and drainage tiling. All sites displayed impaired water quality (e.g. high nutrient and suspended solid concentrations), although tree-shaded sites displayed cooler summertime temperatures and significantly faster decomposition rates than open canopy sites. Decomposition dynamics were associated with invertebrate shredder communities. Open sites transported higher suspended chlorophyll a concentrations, displayed greater attached algal biomass, exhibited wider diurnal oxygen fluxes, and were dominated by collector-scraper invertebrate assemblages compared to tree-shaded sites. Agricultural streams were compared with other less impacted drainages, traditional stream concepts were explored, and a conceptual agricultural stream model was proposed. This study identifies land use practices qualitatively implicated in impairing stream water quality. However, large scale watershed manipulation experiments will be necessary inorder to quantitatively predict the effects of agricultural land use practices on stream water quality.
W83-03377

ENVIRONMENTAL PROBLEMS OF RESERVOIR DEVELOPMENT WITH SPECIAL REGARD TO CONDITIONS IN SWEDEN,
Uppsala Univ. (Sweden). Naturgeografiska Inst.
A. Sundborg.
Canadian Water Resources Journal, Vol 7, No 2, p 2-22, 1982. 4 Fig, 17 Ref.

Descriptors: *Hydroelectric power, *Environmental effects, *Reservoirs, Dam construction, *Sweden, Fisheries, Fish populations, Aquatic biota, Sediment transport, Erosion, Water quality, Vegetation, Animal life.

Environmental problems of reservoir development are considered with special regard to hydroelectric power development in Sweden. Methods are outlined for predicting and evaluating the environmental impact and for reducing effects of reservoir construction by corrective and complementary measures. A brief review is offered of effects on local climate, water stages, water discharges, stream conditions, ice conditions, groundwater, shoreline erosion, sediment transport, water quality, sediment deposition, vegetation and animal life, including aquatic fauna and fish populations. Decisions on future use of natural resources should be

based on a sufficient knowledge of possible effects, gained by environmental study programs. Corrective and complementary measures aimed at a preservation of as much as possible of the original landscape characteristics are noted. Compensation for decreased fish production and the establishment of facilities for tourism and recreation are also mentioned. Speaking generally, the development of hydropower may involve marginal advantages to the total electricity production system in Sweden. However, hydropower is especially valuable because of its ease of regulation and its immediate adaptability to the fluctuations in electric energy demand. (Baker-FRC)
W83-03393

AQUATIC ECOLOGY MONITORING NETWORK OF THE JAMES BAY POWER CO. (LE RESEAU DE SURVEILLANCE D'ECOLOGIE AQUATIQUE DE LA SOCIETE D'ENERGIE DE LA BAIE JAMES),
D. Roy.
Canadian Water Resources Journal, Vol 7, No 1, p 229-250, 1982. 8 Fig, 1 Tab, 28 Ref. English summary.

Descriptors: *Monitoring, *Environmental effects, *Reservoirs, Forecasting, Primary productivity, Phytoplankton, *James Bay, *Quebec, Canada, Zooplankton, Benthos, Fish.

The James Bay Power Company (SEBJ) set up an ecological monitoring network in 1977 designed to evaluate the changes in the environment resulting from the creation of reservoirs in Northern Quebec. This information may be of use in later years to improve the methods of predicting impact and to assist specialists in choosing appropriate remedial measures. Generally, systematic observations are made at stations located either on the three main reservoirs or nearby. Baseline data were obtained on various physical chemistry parameters, primary production, phytoplankton, zooplankton, benthos and fish. Conventional mathematical analysis was used to reveal the relationships existing between these parameters. The main changes observed during the first four years that the network has been in operation included slight decreases in dissolved oxygen at the surface and greater decreases near the bottom. Acidification of the reservoirs occurred after the beginning of impoundment due to decomposition of organic matter and leaching of soils with low buffering capacity. Species diversity of plankton decreased, and relative populations of different fish species were altered, although the total fish harvest increased slightly. (Baker-FRC)
W83-03394

AN EVALUATION OF PROPOSED CAGE FISH CULTURE ON LOCH LOMOND, AN IMPORTANT RESERVOIR IN CENTRAL SCOTLAND,
Stirling Univ. (Scotland). Inst. of Aquaculture.
M. Beveridge, and J. F. Muir.
Canadian Water Resources Journal, Vol 7, No 2, p 181-196, 1982. 3 Fig, 1 Tab, 32 Ref.

Descriptors: *Fisheries, *Lakes, *Environmental effects, Water quality, Loch Lomond, *Scotland, Fish, Water resources development, Planning, Decision making, *Aquaculture.

Proposals to farm rainbow trout in Loch Lomond, the largest and one of the most important reservoirs in the United Kingdom, are evaluated. The suitability of the Loch is assessed in terms of existing water quality, and optimum sites are chosen on the basis of depth of water, exposure, access, risk from pollution, security and planning regulations. The environmental impact of different size production units is calculated on the basis of phosphorus and nitrogen loadings, and permissible production figures are suggested in the light of current constraints on Loch Lomond as a source of drinking water and as a recreational facility. A study of the environmental impact of wastes for a large cage fish farm is briefly described. (Baker-FRC)
W83-03403

THE DEVELOPMENT AND EFFECT OF FISH ATTRACTORS ON THE TENNESSEE-TOMBIGBEE WATERWAY,
Corps of Engineers, Mobile, AL. Mobile District.
K. R. Sims.
Canadian Water Resources Journal, Vol 7, No 2, p 163-171, 1982. 1 Fig, 9 Ref.

Descriptors: *Reservoirs, Construction, *Environmental effects, *Planning, Decision making, Management, Water resources development, Lakes, Fish, *Fish attractors, *Tennessee-Tombigbee Waterway.

A pre-construction planning effort is described whereby fish attractors were designed and incorporated into the lakes along the Tennessee-Tombigbee Waterway (TTW). Reservoir clearing practices were modified, and naturally occurring resources were used to construct approximately 150 fish attractors in nine lakes. The approximately one hectare fish attrators were composed of stumps, about one meter high, and shrub growth, all of which are naturally attached to the lake's bottom. The effects of the fish attractor design on the sport and commercial fisheries, water quality, and public safety of the TTW lakes are also discussed. (Baker-FRC)
W83-03419

DEVELOPMENT OF A RESERVOIR PREPARATION STRATEGY,
Newfoundland and Labrador Hydro, St. John's.
D. J. Kiell.
Canadian Water Resources Journal, Vol 7, No 2, p 112-131, 1982. 3 Fig, 4 Tab, 16 Ref.

Descriptors: Water resources development, *Environmental effects, *Reservoirs, Littoral zone, Fish, Recreation, Water use, Dams, Construction, Planning, Decision making, Management, *Newfoundland.

The value of a reservoir preparation study approach is considered in light of actual clearing costs incurred during construction, the reaction of regulatory agencies, and similar studies completed on other proposed reservoirs in the Province of Newfoundland. An exercise to determine an effective reservoir preparation strategy was begun during the environmental assessment of the Upper Salmon Project, a proposed hydroelectric development in Newfoundland. The study examined forestry resources and wildlife habitat and use in the flood zone. Also considered was the predicted littoral zone development, water quality changes and fisheries impacts. The recommended action was to completely clear selected areas of the reservoir (about 57%), mainly in response to requirements of migrating caribou and in order to enhance recreation potential. Forest areas underlain by gravel material were to be cleared to create salmonid spawning beds in the reservoir. A 200 meter strip between Great Burnt Lake and Crooked Lake was to be cleared to enhance movement to boats between these lakes, and a 200 m strip through the diversion channel areas was also to be cleared. (Baker-FRC)
W83-03420

THE EVOLUTION OF PUBLIC INVOLVEMENT IN RESERVOIR DEVELOPMENTS IN CANADA,
Beak Consultants Ltd., Toronto (Ontario).
W. Eedy, and H. Howes.
Canadian Water Resources Journal, Vol 7, No 2, p 289-304, 1982. 4 Fig, 18 Ref.

Descriptors: *Public participation, *Reservoirs, Water resources development, *Decision making, Planning, Social participation, Management, Water supply, Water management, *Canada.

The evolution of socio-economic impact studies and public involvement requirements related to reservoir development and management across Canada are reviewed. The extent of public involvement in impact assessments of reservoir developments is a function of a variety of factors, including government requirements, geographic location, time, and expectations of the public as well as the client. Environmental and socio-economic studies are compared for reservoir developments in Nova Scotia, Labrador, Ontario, and Saskatachewan. These span a 6 yr period in which federal and provincial guidelines as well as public environmental awareness have evolved considerably. These projects also allow a comparison of public and government expectations relevant to socio-economic studies and public participation in regions with great variation in lifestyle, resource values, and environmental awareness. The public and political concerns raised through these projects ranged from Native land claims and resource uses, through recreational property values, to effects on semiwilderness parkland and loss of prairie farmland. Political ramifications included dealing with diverse ethnic, cultural, and social backgrounds. Innovative public participation approaches were required to convey technological understanding of the engineering and environmental study programs as well as to solicit accurate expressions of concerns over the developments. The increasing importance of public involvement in the decision process is emphasized. (Baker-FRC)
W83-03421

HYDROBIOLOGY OF THE LITTORAL ZONE OF THE DNIEPER ESTUARY UNDER CONDITIONS OF REGULATED FLOW OF THE RIVER,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
M. N. Dekhtyar, L. N. Zimbalevskaya, Y. V. Pligin, N. V. Pikush, and G. A. Goshovskaya.
Hydrobiological Journal, Vol 18, No 1, p 16-21, 1982. 6 Tab, 11 Ref.

Descriptors: *Environmental effects, *Dam effects, *Littoral zone, Water resources development, Dnieper Estuary, Kremenchug Reservoir, Flow regulation, River flow, Invertebrates, Fisheries, Bogs, Reservoirs, Ecosystems, Sediments, Salinity, Biomass, Phytoplankton, Bottom sediments, Estuaries, Shallow water, Benthos, *USSR.

Hydrobiology of the littoral zone of the Dnieper Estuary was studied after construction of 4 dams in the upper river (1956-66) and before the proposed damming of the Dnieper-Bug Estuary. In 1978 freshwater and brackish water organisms became predominant in the littoral zone because the estuary had been freshened to oligohaline in the east and central zones and to mesohaline in the west zone. Biomass of invertebrates and the contribution of oxyphilic species also increased greatly between 1964 and 1978. These changes were caused by regulation of the river flow, which prevented seawater intrusion and extreme changes in water level. At present about 35% of the shallow zone is occupied by silty sediments rich in organic matter and low in invertebrate biomass. The remainder of the shallow zone consists of sand and shell bottom occupied by oxyphilic organisms. Comparison of biomasses in the littoral zones of the existing Kremenchug Reservoir and the undammed Dnieper estuary shows that the Kremenchug has a much smaller density of phytobenthos (4.57 g per sq m) and zoobenthos (10.17 g per sq m) than the undammed estuary, 21.60 g per sq m of phytobenthos and 79.43 g per sq m of zoobenthos. From these observations it is believed that damming the estuary could severely harm or destroy the fishing industry in this area as a result of flow reduction, increase in areas of stagnant water, expansion of the zone of reduced bottom soils, and promotion of bog formation. These conditions discourage growth of invertebrate fish food organisms. (Cassar-FRC)
W83-03480

EFFECTS OF WILDERNESS LEGISLATION ON WATER PROJECT DEVELOPMENT IN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Economics.
G. D. Weaver.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-226910, Price codes: A08 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report, Fort Collins, May 1983. 156 p,

7 Fig, 28 Tab, 157 Ref. OWRT A-044-COLO(1), 14-34-0001-9006 & 0106.

Descriptors: *Wilderness areas, *Environment, *Wildlife conservation, *Wildlife habitats, *Wildlife management, *Wild rivers, *Rivers, *Fish, *Water supply, *Project planning, *Enviornmental effects, *Legislation.

Environmental policies embodied in the Wilderness Act, Wild and Scenic Rivers Act, and Endangered Species Act impose certain restrictions on the development of Colorado's water resources. Planning costs are unavoidably increased because time and personnel must be invested in complying with procedural reequiements of the laws. Capital or operating costs may be increased because of construction delays, required engineering design changes, or spatial relocation of project facilities. In some cases, development opportunities will be completely foregone. The most pervasive conflicts identified in this study involve the endangered whooping crane and Colorado River fishes. New streamfow depletions in the Platte River system will adversely affect the whooping crane habitat in central Nebraska if such depletions occur between February 1-May 10 or September 16-November 15. Accordingly, new development will be given nonjeopardy biological opinions only if they can meet the required flow regime, either by providing storage releases or replacement waters, or if they can offset the effects of small depletions by funding habitat improvement programs. Approval of projects affecting the Colorado River fishes have already been made contingent upon project operators adopting or funding various conservation measures, including the bypassing of minimum flows during critical months of the year.
W83-03489

7. RESOURCES DATA

7A. Network Design

LANDSAT MONITORING OF IRRIGATED FARMLAND ACREAGE IN CURRY COUNTY, NEW MEXICO,
New Mexico Univ., Albuquerque. Technology Application Center.
M. Inglis, and T. K. Budge.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220566, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Technical Report No 165, New Mexico State Univ., Las Cruces, February 1983. 46 p, 16 Fig, 4 Tab, 9 Ref. OWRT A-069-NMEX(1), 14-34-0001-1133.

Descriptors: *Irrigated land, *Remote sensing, Groundwater mining, Acreage, Phenology, *Image processing, *Landsat satellite, *Classification, *New Mexico, Curry County.

Groundwater depletion is an increasing problem in the High Plains and poses economic difficulties in eastern New Mexico. Farming practices must change to adjust to the supply of irrigation water. A method to improve on the time and labor currently required to measure irrigated acreages would help to better predict the future supply of groundwater. Curry County, New Mexico, was selected as the study area to test the applicability of Landsat satellite digital data in making accurate acreage measurements of irrigated cropland. Due to its digital format, large image area, and repeating coverage, Landsat data have been found to be excellent for large area resource inventories. Three Landsat digital images of the 1981 growing season were classified for Curry County to determine (1) how well Landsat classified irrigated lands in the area, (2) how accurate Landsat acreage measurements could be, and (3) how many Landsat overpass dates would be required to accurately measure irrigated acreage. Results showed that three times periods of Landsat data produced an acreage count which was 94.4% of the official published figure. This report describes the methodology employed and makes recommendations for an operational yearly inventory of New Mexico cropland using satellite data.
W83-03310

EVALUATION AND ACCESSING OF DATA FOR A WATER RESOURCES SIMULATOR,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
R. C. Peralta, R. Arce, and T. Skergan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222232, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 91, Univ. of Arkansas, Fayetteville, March 1983. 29 p, 19 Ref, 4 Append. OWRT A-060-ARK(1), 14-34-0001-2104.

Descriptors: *Data collections, *Monitoring, *Data acquisition, Well data, Groundwater management, Grand Prairie, *Arkansas.

An evaluation was made of the availability of data needed to use a groundwater simulation model for real time conjunctive water management in the Arkansas Grand Prairie. It is assumed that the goal of such management is to protect existing groundwater rights by maintaining water levels so that wells do not go dry, even in time of drought. Suffucient hydrogeologic data exists to use the simulation model to predict the effect of known pumping rates on groundwater levels. Developing an optimal set of 'target' levels and annually managing pumping to achieve those levels requires additional data: fall groundwater levels, degree of connection between aquifer and recharge streams, and annual cell by cell prediction of aquaculture and irrigated agriculture acreages. Successful management also requires continuous monitoring in the critical area where saturated thicknesses are small.
W83-03334

7B. Data Acquisition

SAMPLING MACROFAUNA IN DITCHES,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Landscape Ecology and Nature Management.
B. Beltman, and W. Rietveld.
Hydrobiological Bulletin, Vol 15, No 3, p 153-159, December, 1981. 4 Fig, 16 Ref.

Descriptors: *Macroinvertebrates, *Sampling, *Ditches, Aquatic animals, Water quality, Water analysis, Water pollution effects, Biological communities.

Techniques for sampling macrofauna were compared for the purpose of determining the optimum method for sampling in ditches. For total macrofauna, use of a standard net method is preferable to sampling with the bottomless cage, dredge, macrofauna shovel, substrate sample, and metal wire kitchen sieve. A 5 m standard net sample is considered a minimum for a representative sample. If several habitats are present, the sample size should be increased to include them. A selective sample (collecting all animals within a 1.5 meter compartment of a ditch) gave a reasonable indication of the fauna, about 50-60% of the total 145 taxa revealed by standard net sampling. The sampling method should be designed according to the purpose of the survey, which may be total macrofauna or correlations between plant species and macrofauna taxa.
W83-03217

CONTRIBUTION TO THE MEASUREMENT OF EVAPORATION IN REMOTE STATIONS (BEITRAG ZUR VERDUNSTUNGSMESSUNG IN ABGELEGENEN STATIONEN),
Salzgitter A.G. (Germany, F.R.).
H. Wittenberg.
Wasserwirtschaft, Vol 71, No 1, p 6-9, January, 1981. 5 Fig, 7 Ref. English Abstract.

Descriptors: *Climatic data, *Weather, *Measuring instruments, *Evaporimeters, *Field tests, Climates, On-site tests, Evaporation pans, Evaporation, Deserts, Arid lands, *Egypt, Sahara Desert.

For a climatological station in the Egyptian Sahara, where regular attendance could not be guaranteed, two types of evaporimeters were installed and their performance was compared. A Class-A pan with a supply tank and inflow regulator and a Czeratzki ceramic evaporimeter with recorder and automatic filling device were each installed, and a twelve month record of data was obtained. Regression analysis of the data revealed close correlations, with a coefficient of 0.89. Both instruments produce high quality data. (Titus-FRC)
W83-03225

FIELD RATING EVALUATION OF A LARGE SUPERCRITICAL MEASUREMENT FLUME,
D. L. Chery, and R. E. Smith.
ISA Transactions, Vol 21, No 1, p 55-60, 1982. 8 Fig, 1 Ref.

Descriptors: *Flumes, *Flow measurement, *Ephemeral streams, Walnut Gulch, Watershed, *Arizona, Sediment transport, Sediment-carrying capacity, Sediment load, Stream discharge, Streamflow, Asymmetrical flow, Open-channel flow, Flow velocity, Flow characteristics, Flow profiles, Flood flow, Flow pattern, Hydraulic profiles, Flash floods, Channel flow.

Eleven supercritical flumes were developed for measuring flow in the Walnut Gulch watershed, Arizona, where ephemeral flows often carry heavy and variable sediment loads. Accurate measurement of discharges in ephemeral streams is difficult because of these high velocities, the sediment-carrying capacity of high velocities, and temporal variations of the stream bed shape and local flow direction. Number 6 flume was fitted with special instrumentation capable of measuring the extremes in flow velocity and water depth. During 1974-77 15 flow events were measured, of which four were chosen as representative of the range of average flow depths, 0.38-0.89 m. Discharges were 1.81-29.3 cu m per sec. Velocity contours, surface profiles and rating relations for these four events showed that asymmetrical flow at depths up to about 1 m produced measurement bias. At flows above 1 m in depth, measured and calculated discharges agree more closely. Porous control dikes installed in the upstream channel significantly improved the symmetry and rating relations for flows in the flume throat. (Cassar-FRC)
W83-03239

OPPORTUNITIES AND POTENTIAL BENEFITS OF RADAR RAINFALL MEASUREMENTS FOR THE FEDERAL REPUBLIC OF GERMANY (MOGLICHKEITEN UND POTENTIELLER NUTZEN EINES BUNDESDEUTSCHEN NIEDERSCHLAGSRADAR--VERBUNDSYSTEMS),
Deutscher Wetterdienst, Hohenpeissenberg (Germany, F.R.). Meteorologisches Observatorium.
W. Attmannspacher, and G. Schultz.
Wasserwirtschaft, Vol 71, No 1, p 1-5, January, 1981. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Measuring instruments, *Precipitation, *Climatic data, *Hydrologic data, *Electronic equipment, Rainfall, Hydrologic data collection, Radar, Rain gages, Meteorological data collections, Electrical equipment, *Federal Republic of Germany.

A method of measuring area precipitation was developed by researchers at the Hohenpeissenberg Observatory. This method has usefulness in various branches of science, including hydrology and meteorology, and would be of particular benefit in detecting flood problems. Rainfall measurements are computed from a conversion formula based on radar pulses emitted from electronic rainfall detectors. The results lead to isohyet maps with greater detail than those obtained by conventional methods, and the transformed data is available within one hour after the storm event. (Titus-FRC)
W83-03240

ON THE ESIMATION OF THE ERROR OF SOIL MOISTURE MEASUREMENT BY MEANS OF A NEUTRON SCATTERING PROBE (ZUR ABSCHATZUNG DES FEHLERS DER BODENFEUCHTE-MESSUNG MIT EINER NEUTRONENSONDE),
Freiburg Univ. (Germany, F.R.).
G. Morgenschweis.

Wasserwirtschaft, Vol 71, No 1, p 10-15, January, 1981. 4 Fig, 3 Tab, 21 Ref. English abstract.

Descriptors: *Soil moisture meters, *Soil water, *Soil density probes, *Measuring instruments, *Calibrations, Soil properties, Soil density, Field tests, On-site tests, Sites, Errors.

The problems of soil moisture measurement by means of a neutron scattering probe and its errors are demonstrated for an example of loessial sites in the Kaiserstuhl. Studies were conducted on soil horizons to a depth of 10 meters. An approach to field calibration which considers dry bulk density is presented. Soil moisture measurements are considered among the most difficult of hydrological measurements; the instrumental error of the rate-meter and the error in determining soil density are used to estimate the error of the soil moisture measurements. (Titus-FRC)
W83-03242

MONITORING OF GROUNDWATER LEVELS FOR REAL-TIME CONJUNCTIVE WATER MANAGEMENT,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
R. C. Peralta, V. Mazur, and P. Dutram.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222224, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 92, Univ. of Arkansas, Fayetteville, March 1983. 23 p, 2 Fig, 3 Ref, 6 Append. OWRT A-061-ARK(1), 14-34-0001-2104.

Descriptors: Grand Prairie, *Groundwater level, *Monitoring, Aquifer management, *Data acquisition, *Arkansas.

Water users in the Arkansas Grand Prairie wish to maintain sufficient groundwater levels to: insure adequate groundwater reserves for time of drought, protect themselves from litigation caused by wells going dry, and insure a sustained yield. Achievement of these goals requires regular measurement of groundwater levels. Review of monitoring practice and technology indicates that spring and fall measurements taken over the entire area using steel tape and acoustic device is preferred for most long range planning. Continuous monitoring is indicated for critical parts of the region where saturated thicknesses are small. Desirable attributes of a data collection/transmission system for such areas are as follow: Date should be stored in digital format on machine readable medium. Collection device should be installable in existing wells and not require special well construction. Device should be able to monitor pump status, and time and water level at programmable intervals. Device should be upgradable to be able to transmit data as it is collected. A system which has these capabilities was built. It consists of an acoustic probe, interface, computer and cassette recorder.
W83-03333

RAINFALL CELL SIZE FROM RIT CURVE ANALYSIS,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 2B.
W83-03339

CHARACTERIZATION OF KEL-F-GRAPHITE COMPOSITE (KELGRAF) ELECTRODES AND APPLICATION TO DETECTION IN FLOWING STREAMS,
North Dakota State Univ., Fargo. Dept. of Chemistry.
D. E. Tallman, and D. E. Weisshaar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224204, Price codes: A12 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State University, Fargo, January 1983. 258 p, 92 Fig, 20 Tab, 97 Ref. OWRT B-055-NDAK(1).

Descriptors: *Electrodes, *X-Ray spectroscopy, Heterogeneity, Electron microscopy, Electrochemistry, Groundwater, *Phenols, Analytical technique, Instrumentation, Prototype tests, *Chronoamperometry, *Pollutant identification, Chemical analysis.

The active area of Kel-F-graphite composite (Kelgraf) electrodes determined from short time chronoamperometric data agree well with the weight percent of graphite in the composite and with the percent conducting carbon on the surface determined from X-ray photoelectron spectroscopy (XPS). the model of Gueshi et al. (1) for partially blocked electrode surfaces was modified by introducing heterogeneity in the form of two different active site sizes. This modified model was fit to the chronoamperometric data by a simplex optimization of model parameters to determine the average active and inactive site radii on Kelgraf electrode surfaces. These radii are in agreement with those estimated from scanning electron microscopy (SEM). The performance of Kelgraf as an electrode for electrochemical detection in flowing streams is discussed, including the determination of the optimum electrode composition and the linear dynamic range of the detector. The detector was applied to the determination of phenols in groundwater and coal gasification wastewater. Detection limits ranged from 3-15 pg for a variety of phenols. No fouling of the electrode was evident. Evidence based on chronoamperometry, XPS, SEM, cyclic voltammetry, and capacitance measurements point to the existence of a partial thin film of Kel-F over portions of the graphite sites. The implications of the presence of such a film are also discussed.
W83-03369

A METHOD FOR IMPROVING CHEAPLY THE TIME RESPONSE OF PRESSURE-TRANSDUCER TENSIOMETER SYSTEMS,
Rothamsted Experimental Station, Harpenden (England).Dept. of Physics.
G. D. Towner.
Agricultural Water Management, Vol 5, No 4, p 285-293, December, 1982. 3 Fig, 5 Tab, 7 Ref.

Descriptors: *Pressure-measuring instruments, *Tensiometers, Soil water, Gages, Manometers, Transducers.

The time response of a system with multiple tensiometers scanned by a single pressure transducer is theoretically reduced by connecting a deformable cell to the cup. If this cell is disconnected immediately after the transducer has been exposed to it, the soil water pressure reading can be obtained in much less time. A Bourdon gage is sensitive enough to fulfill the theoretical requirements; a mercury manometer is not. (Cassar-FRC)
W83-03409

USE OF SEEPAGE METERS AND MINI-PIEZOMETERS FOR IDENTIFICATION OF RESERVOIR - GROUNDWATER INTERACTIONS IN LAKE MEAD, NEVADA,
Montana Univ., Missoula. Dept. of Geology.
W. W. Woessner, and K. Sullivan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-226894, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center, Desert Research Institute. Publication No 41082, Nevada Univ., Las Vegas, May 1983. 12 p, 8 Fig, 18 Ref. OWRT A-097-NEV(1), 14-34-0001-0130.

Descriptors: Bank storage, *Piezometers, *Seepage meters, Groundwater movement, *Nevada, *Surface-groundwater relations, *Lake Mead, *Groundwater-reservoir interactions.

The effectiveness of the seepage meter and portable piezometer in evaluating groundwater-reservoir interactions was evaluated over 12 months at Echo Bay in Lake Mead. Three standard piezometers constructed on shore, a refraction seismic technique and water chemistry data were utilized to interpret seepage device effectiveness. During a period of an 8 ft (2.4 m) rise in reservoir stage (12-79 to 3-80) the reservoir contributed water to bank storage at rates of up to 0.29 gpd/ft super 2 (12 lpd/m super 2). Groundwater discharge occurred for the remainder of the project, during a stage decline (4-80 to 5-80), a rise (6-80) and leveling off and slight decline for the remainder of the year (7-80 to 12-80). The maximum seepage meter groundwater discharge rate was recorded in December 1980, 3.0 gpd/ft super 2 (122 lpd/m super 2). Analysis of water quality data showed June discharge was principally at low TDS sodium-calcium-sulfate water similar to Lake Mead water quality. September data showed two possible components of discharge, bank storage water and high TDS calcium-sulfate groundwater. December groundwater discharge water quality data showed a high TDS calcium-sulfate water at all seepage meter locations and in wells 2A and 2B. Mini-piezometer data was collected at each seepage meter site, however data usually did not provide correlative results with seepage meter data. Suspended sediment in the piezometer water column and plugging of the perforated tip are suggested to explain unreliable results.
W83-03487

7C. Evaluation, Processing and Publication

HYDROLOGY OF AREA 14, EASTERN COAL PROVINCE, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
F. Quinones, D. S. Mull, K. York, and V. Kendall.
Geological Survey Open-File Report 81-137 (WRI), August 1981. 82 p, 37 Ref, 7 Append.

Descriptors: *Hydrologic data, *Water quality, *Groundwater, *Surface water, *Strip mines, Geohydrology, Acid mine drainage, Water pollution sources, *Kentucky, Eastern Coal Province, Kentucky River basin, Licking River basin, Red River basin.

The general hydrology of Area 14, Eastern Coal Province, in Kentucky, is described. The area includes 4,423 square miles in the Kentucky, Licking, and Red River basins. Coal-bearing rocks of Pennsylvanian age underlie most of the area. Coal production in 1978 was about 38 million tons, 65% of which was from surface mining. The drainage from the mined areas contains large amounts of dissolved solids. Sulfate, manganese, and iron concentrations in most of the area streams exceed background levels, with the higher concentrations in streams draining the headwaters of the North and Middle Forks of the Kentucky River. The pH of most of the streams is near neutral acid-mine drainage being partially neutralized close to its source. Ground waters in the upper 300 feet of the aquifers are generally suitable for most purposes, although dissolved iron is generally high. Below 300 feet, the water is saline. Yields to wells range from 1 to 325 gallons per minute. A network of 66 surface quantity and quality of water stations was implemented in 1979 in response to the Surface Mining and Reclamation Act of 1977. An intensive study of the ground water resources of the area is also in progress. (USGS)
W83-03355

WATER TYPE AND SUITABILITY OF OKLAHOMA SURFACE WATERS FOR PUBLIC SUPPLY AND IRRIGTION. PART 3: CANADIAN, NORTH CANADIAN, AND DEEP FORK RIVER BASINS THROUGH 1979,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. D. Stoner.
Geological Survey Water-Resources Investigations 81-80, May 1981. 210 p, 6 Fig, 3 Tab, 16 Ref.

Descriptors: *Water supply, *Irrigation, *Surface water, *Data collections, *Water quality, Water analysis, Trace elements, Hardness, Water use, *Oklahoma, Canadian River basin, North Canadian River basin, Deep Fork River basin.

Water-quality data through 1979 in the Canadian, North Canadian, and Deep Fork River basins within Oklahoma were examined for water type and suitability for public water supply and irrigation use. Of 105 stations with available data, 47 stations or 45% were considered to have sufficient

data for analysis. The classification fo water type was based on the relation of the major ions: calcium, magnesium, sodium, carbonate, bicarbonate, sulfate, and chloride to each other within the range of measured specific conductance. The suitability for use as a public supply was based on the concentration distribution of selected constituents. The constituents selected were those with maximum contaminant levels established by regulation, or constituents for which recommended maximum limits have been established and for which historic data are available. The irrigation classification method of Wilcox was used to relate sodium, calcium, and magnesium concentrations and the salinity distribution to the use of the water for irrigation. Where data were available, the chance of phytotoxic effects by boron was discussed. (USGS)
W83-03362

8. ENGINEERING WORKS

8A. Structures

SOIL COLLAPSES ON SHORES OF CLEAR LAKE RESERVOIR, MODOC COUNTY, CALIFORNIA,
Water and Power Resources Service, Sacramento, CA. Mid-Pacific Region.
N. P. Prokopovich.
Bulletin of the Association of Engineering Geologists, Vol 19, No 4, p 327-332, November, 1982. 5 Fig, 8 Ref.

Descriptors: *Reservoirs, *Collapse, Construction, *California, Clear Lake Reservoir, Maintenance, Soil Properties, Leaks, Infiltration.

Peculiar soil collapses on the western shore of Clear Lake Reservoir in Modoc County were investigated. This reservoir has high seepage water losses, amounting to about 20% of the average water inflow. Soil collapses are relatively common in 'leaky reservoirs'. Most can be attributed to one of three processes: first, the increase in weight of overburden capping preexisting cavities brought about during or shortly after initial flooding causes cave-ins; second, the piping of overburden into cavities by seeping reservoir water can cause collapses in submerged portions of the reservoir. The third process, probably invalid in the present case, is collapse caused by subsidence due to an increase in the actual weight of the overburden above an open lava tube or fissure, due to losses of buoyance during the lowering of the reservoir levels. Major cavities noted in Clear Lake Reservoir in 1959 and 1977 were repaired to prevent water losses. (Baker-FRC)
W83-03189

FLUSHING OF RESERVOIRS AS A MEANS OF INCREASING THE OPERATING EFFICIENCY OF HYDROELECTRIC STATIONS,
A. S. Vorob'ev.
Hydrotechnical Construction, Vol 15, No 9, p 517-521, 1981. 1 Fig, 2 Tab, 4 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 9, p 14-16, September, 1981.

Descriptors: *Flushing, *Reservoir silting, *Sediment control, Reservoir capacity, Reservoir operation, Hydroelectric plants, Operating policies, Electric power production, Silting, *USSR, Chir-Yurt Reservoir, Sulak River.

The advantages of flushing reservoirs to increase storage capacity and reduce damages from excess sediments are demonstrated by several examples. The Chir-Yurt reservoir on the Sulak River, USSR, was flushed in 1968, resulting in removal of 8 million cu m of sediment in 4 days. This 100 million cu m reservoir had become 90% silted within 5 years of its initial operation. Normal operating conditions were maintained for several years afterwards. The Golovnaya hydrostation reservoir on the Vakhsh River was not shut down during a flushing operation, which removed 2.2 million cu m of sediment within 6 days with a 4.5 m lowering of the water level. For the year 1979 increases in electric power production at Chir-Yurt hydrostation after flushing were 32.5 million kWh from decreasing idle discharges and 4.1 million kWh from increasing the average head. (Cassar-FRC)
W83-03198

THE MEGGET SCHEME.
Water Services, Vol 86, No 1038, p 371-372, August, 1982.

Descriptors: *Water supply, *Water resources development, *Construction, Dams, Pipes, Pipelines, Megget Scheme, *Scotland, Spillways.

The Megget scheme will serve to augment the Lothian Region's water supply and increase the amount of water available to Edinburgh by about 60%. The dam is 56 m high, with a crest length of 568 m and a capacity of 61,400 M liters. The drawoff and overflow works compromise two eccentric concrete towers. The top of the outer tower forms the spillway, and water passes down the annular space between the towers to culverts below. The first stage of the scheme is projected to meet water demand in the region for many years. The second stage will include pumping water from St. Mary's Lock into the Megget reservoir and laying a duplicate pipeline parallel to the existing one. This will meet supply requirements well into the next century. (Baker-FRC)
W83-03248

BUILDING BRAZIL'S NOVA AVANHANDAVA DAM,
Companhia Energetica de Sao Paulo (Brazil).
C. R. de Moraes Leme.
International Water Power and Dam Construction, Vol 34, No 11, p 47-51, 1982. 7 Fig.

Descriptors: *Dams, *Construction, Design criteria, Banks, Earth dams, Soil characteristics, *Brazil, Nova Avandandava Dam.

The completion of the Nova Avanhandava dam in Brazil and the associated works marks a further stage in the construction of a 1000 km navigable waterway linking the Tiete and Parana rivers at Itaipu and Barra Bonita, respectively. It has also added 300 MW of capacity to the country's electrical system. Its construction procedures are described in this article. The hydroelectric plant comprises the intake, powerhouse, erection bay and draft tube, three Kaplan turbines in concrete spiral cases and three-phase synchronous generators for the generation units. Hydraulic model testing showed that a horizontal anti-vortex beam was needed. The crest elevation for the dam was determined at 361.50 m. The surface spillway is 85 m wide, with a crest elevation of 343 m. It was decided to construct homogeneous earth embankments in both abutments. Further studies showed the convenience and economic advantages of placing the rock from the navigation lock on the right abutment dam. For the left bank dam the saprolite material that occurs under the colluvial soil in the left borrow area on a part of the upstream slope was used. (Baker-FRC)
W83-03253

MANAGING FOR WAVES ON NEBRASKA'S LAKE MCCONAUGHY - AN OVERVIEW,
Nebraska Water Resources Center, Lincoln.
M. L. Quinn.
Canadian Water Resources Journal, Vol 7, No 2, p 63-89, 1982. 12 Fig, 3 Tab, 20 Ref.

Descriptors: *Waves, *Reservoirs, *Storms, Lake McConaughy, Dams, Lakes, Wind, Water management, Construction, Riprap, Kingsley Dam, Fetch, *Nebraska.

Field investigation for Kingsley Dam on the North Platte River in Western Nebraska began in 1936, and dam construction began in 1938. Reservoir storage began in February 1941, and a peak elevation of 968.3 m was reached in June 1941. The resulting Lake McConaughy was one of the first large reservoirs to be built on the Great Plains and serves both irrigation and hydroelectric purposes. Wind/wave problems had previously been encounted on the Great Plains, but the magnitude of problems produced at this location by the long stretch of open water coinciding with the direction of seasonally strong winds was not anticipated. Apparently primarily for the sake of cost considerations, articulated precast concrete block was selected for slope protection. Repeated incidents of wave damage required reconstruction of the slope protection layer in 1942-46 and costly repairs at intervals thereafter. In 1959-63 concrete hexapods, usually used for seacoast protection, were attached to the wave wall using heavy cables. In May 1972 a protracted, severe windstorm, with waves up to 3 m in height seriously damaged the slope protection. Washout areas were repaired with a sand/gravel/stone filter structure. Reservoir operating policy was modified to permit a maximum water elevation of 994 m during the storm-prone season and 995.4 m for the rest of the year. Subsequent damage has been minimal, but research on the unusual wind-wave phenomena at Lake McConaughy is continuing. (Baker-FRC)
W83-03426

POSSIBILITY OF REDUCING ENERGY COSTS FOR WATER CONVEYANCE USING A PRELIMINARY RESERVOIR (EINSPARMOGLICHKEIT AN ENERGIEKOSTEN ZUR WASSERFORDERUNG DURCH EINSATZ EINES VORBEHALTERS),
S. Mattyus.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 5, p 201-205, May, 1981. 5 Fig. English abstract.

Descriptors: *Pumped storage, *Reservoirs, *Reservoir design, *Water pressure, Storage, Pumping, Reservoir operation, Storage reservoirs, Multireservoir networks, Water distribution, Water conveyance, Federal Republic of Germany.

A pumped storage reservoir with a small surface but large depth can be placed in front of a main reservoir at the same, greater, or lesser elevation. The water level in the pumped storage reservoir can be regulated to match water demand through the use of pumps and valves. When the pumped storage reservoir is at the same or a lower elevation, energy costs are reduced. When the pumped storage reservoir is at a higher elevation, water in the main reservoir is still available during peak demand periods. The capacity of the main reservoir is thus fully utilized, and the distribution network is protected from unnecessarily high pressures. (Author's Abstract)
W83-03459

8B. Hydraulics

FLUID MECHANICS - THE GREEN FUNCTION OF THE NEUMANN-KELVIN PROBLEM IN A CANAL,
Nantes Univ. (France).
C. Do.
Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, Vol 294, No 17, p 1053-1056, May, 1982. 6 Ref. English summary.

Descriptors: *Flow, *Canal design, *Velocity potential, *Fluid flow, *Hydraulics, Canals, Fluid, Gravity flow, Mathematical studies, Fourier analysis, Mathematical analysis, Mathematical equations, Surface velocity, Surface flow.

A source of constant strength moves with a uniform motion inside a horizontal rectangular cylindrical canal, filled with an incompressible fluid limited by a free surface in the gravity field. The resulting flow is presumed to be steady past a mark linked relatively to the source. The velocity potential of the flow generated by this source is the Green function of the Neumann-Kelvin problem. A constructive Fourier method leads to an existence, uniqueness, and representation theorem for this Green function. Downstream from the source, the velocity potential is the sum of a term defining a uniform flow, a term corresponding to a surge engendered by the source and reflected from the walls, and the third term which decreases rapidly with increasing distance. (Titus-FRC)
W83-03188

THE CONSTRUCTION AND OPERATION OF AN ARTICULATED LABORATORY FLOW CHANNEL,
Bolton Inst. of Tech. (England). Dept. of Civil Engineering.
W. R. Lomax.
Water Services, Vol 86, No 1038, p 387-388, August, 1982. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Channels, *Flow characteristics, *Flow profiles, Flow channels, Flow measurement, Flow pattern, Hydraulics, Computers.

The design and construction of a hinged flow channel for use in a hydraulics teaching laboratory are described. Details are outlined of a method for generating theoretical surface profiles by means of an interactive computer program. While most laboratory flows are suitable for the investigation of rapidly varying flow situations, the situation is somewhat limited if the requirement is to generate and measure a composite, gradually varied, non-uniform flow profile. This problem is overcome by constructing a long channel with a number of hinges, which enable a series of channel lengths or reaches to be set up with different bed slopes. The arrangement for the supply of water to the channel makes use of an existing constant head supply tank at high level and a storage tank below floor level. A number of well known control structures can be inserted into the channel in order to generate a particular profile combination. (Baker-FRC)
W83-03230

HYDRAULIC CRITERIA FOR THE DESIGN OF WEIR SILLS (HYDRAULISCHE ENTWURFS- UND BEMESSUNGSKRITERIEN FUR SOHLSCHWELLEN),
Stuttgart Univ. (Germany, F.R.).
P. Muller, and H. Kobus.
Wasserwirtschaft, Vol 71, No 1, p 295-298, October, 1981. 8 Fig, 6 Ref. English abstract.

Descriptors: *Measuring instruments, *Weirs, *Gages, *Discharge measurements, Flow, Rivers, Gaging stations, Stream gages, Fisheries, Recreation, Water sports, Stream discharge, Flow discharge.

By installation of weir sills as discharge measurement structures at water gauges, it is possible to improve the determination of low discharges in streams. A method of determining the appropriate dimensions for weir sills in rivers is presented. The method is the result of a two year research effort; it applies to rivers ranging from 5 to 30 meters in width and with peak flows up to 100 cubic meters per second. The positioning and angle of the weir is critical, since improper location will alter the stream banks. Canoeing and fish ladders impose constraints on the height of a weir. Design is based on an analysis of both stream flow patterns and stream configuration. (Titus-FRC)
W83-03241

MODELLING THE FLOOD ALLEVIATION SCHEME FOR THE USK AT BRECON,
T. E. Evans, E. Chang, and B. Brighouse.
Water Services, Vol 86, No 1038, p 397-399, August, 1982. 5 Fig, 1 Tab, 4 Ref.

Descriptors: *Flood control, *Construction, *Model studies, Channel flow, Floods, Predicting, Estimating, Bridges, Usk River, *Wales, Flood protection, Hydrologic models, Mathematical models, Scour, Hydraulics.

A feasibility study was prepared for the Welsh Water Authority to evaluate the size and frequency of occurrence of floods in Brecon and assess the economics of alternative measures to reduce the flood risk. Detailed designs were then prepared, and construction of the works proposed is to be carried out between September 1981 and September 1982. Because of the irregular flow distribution through the bridge and due to the lack of recorded data to calibrate the mathematical hydrological model for a range of flood levels, the head loss through the bridge could not be predicted by using an analytical solution alone. Subsequently, model tests of the Llanfaes bridge, Brecon, showed that with a 1 in 100 year flood, supercritical flow will occur through the bridge. In view of this, the lowering of the bridge invert and the raisig of the proposed embankments and walls below the Llanfaes bridge were recommended as an alternative to the extensive downstream channel improvements previously proposed. (Baker-FRC)
W83-03247

HYDRAULIC ANALYSIS OF SURCHARGED STORM SEWER SYSTEMS,
Kentucky Water Resources Research Inst., Lexington.
D. J. Wood, and G. C. Heitzman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-224238, Price codes: A08 in paper copy, A01 in microfiche. Research Report No 137, March 1983. 152 p, 43 Fig, 11 Tab, 54 Ref. OWRT A-084-KY(1), 14-34-0001-1119, 14-34-0001-2119.

Descriptors: *Storm sewers, Flow, Transition flow, *Unsteady flow, *Sewer systems, Sewers, Model studies, *Finite element analysis, Computer programs, *Hydraulics, Hydraulic grade.

The primary objective of this report was to carry out a investigation which would be a basis for the development of a hydraulic flow model for the analysis of storm sewer systems at peak flows. The unsteady distributed parameter finite element model provided the most accurate and reliable solution of the system continuity and momentum equations. It is recommended that a finite element model woould provide a useful tool for the analysis of transients in closed conduits. The dynamic lumped parameter model provides a simple reliable method for the analysis of storm sewer systems under surcharge. The kinematic model is a time modified steady flow model which predicts total head flow values from previously known steady state conditions. These flow models are applied to several example storm sewer systems under surcharge conditions. Plots of hydraulic grade and flow throughout the sewer systems under surcharge conditions are presented to evaluate the ability of each model to accurately analyze storm sewer systems under surcharge. Computer programs are developed for each model.
W83-03374

INLET CONSTRUCTION FOR VORTEX DROPS WITH SUPERCRITICAL INFLOW (EINLAUFKONSTRUKTION FUR WIRBELFALLSCHACHTE MIT SCHIESSENDEM ZUFLUSS),
Technische Univ., Munich (Germany, F.R.). Inst. fuer Hydraulik und Gewasserkunke.
A. Kleinschroth, and G. Koplitz-Weissgerber.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 5, p 212-215, May, 1981. 5 Fig, 7 Ref.

Descriptors: *Vortices, *Hydraulic engineering, *Rapid flow, *Design criteria, *Construction methods, Flow characteristics, Hydraulics, Hydrodynamics, Flow, Model studies, Overfalls, Vortex drops, Prediction, Mathematical studies, Mathematical equations, Wastewater facilities, Flood control.

A construction design and calculation procedures were developed in an attempt to eliminate the need for hydraulic model experiments in the design of vortex drop inlets with supercritical inflow. Simplicity of form and space saving were important factors influencing construction design, which consists of a complex curve in which the ratio of inflow-channel width and shaft diameter can be selected such that the width/diameter ratio equals approximately 1/2. The base, tranverse to the direction of flow, is horizontal. The incline, which is in the same direction as the flow, depends on the available height for construction, and its angle should be between 10 and 20%. Equations are given to calculate outflow, the relationship between vertical and tangential speed components at the inlet, the vertical component of outflow speed, the vertical components of speeds in various sections of the shaft, maximal flow depth in the vortex chamber, and maximal outflow, whereby such assumptions as the existence of a constant energy level in the inlet area and a linear pressure distribution in the annular jet at the inlet as well as equal total speeds at the narrowest point of the vortex and at the start of the shaft are in effect. To test these theorectical results, a model was constructed with an inflow-channel width of 70 mm, a shaft diameter of 140 mm, and inclines of between 2 and 20% for the inflow channel and 5 and 20% for the vortex chamber. The predicted maximal outflow of 30 l/sec could not be matched in practice (above 25 l/sec outflow became turbulent and sometimes overflowed from the vortex chamber). Maximal water depths achieved in the water chamber agreed well with the predicted level. Agreement between theory and experiment was good enough that the calculated results would be useful in practice. (Gish-FRC)
W83-03481

8C. Hydraulic Machinery

SLIDE VALVES SAVE COSTS.
Water Services, Vol 86, No 1032, p 66, February, 1982. 1 Fig.

Descriptors: *Hydraulic equipment, *Penstocks, *Hydraulic valves, Water conveyance, *United Kingdom.

Wey slide valves and penstocks, manufactured and marketed in the United Kingdom by The Reiss Engineering Company Limited, have been instrumental in achieving substantial savings in sewage treatment plants. Both the slide valves and the penstocks utilize a knife-edge door and nitrile resilient rubber seals both around the periphery of the door and in the transverse position on each face of the door. The slide valve combines modern technology in sealing techniques with the advantages of simple construction, few basic components, and quick-action, and 'free-flow' design in order to deliver virtually full-bore flow characteristics with minimal pressure drop and positive sealing. Special flush-out corners in the slide valves andd penstocks force any accumulated deposits into the flow during the closing movement. Both the slide valves and the penstocks are designed for simple routine maintenance and long and trouble-free operating lives. (Carroll-FRC)
W83-03232

VALVES, PENSTOCKS AND ACTUATORS: RELIABLE CONTROL OF WATER SYSTEMS,
For primary bibliographic entry see Field 5F.
W83-03245

KEEPING THE FLOW SMOOTH.
Water Services, Vol 86, No 1032, p 69, February, 1982.

Descriptors: *Hydraulic equipment, *Air valves, *Valves, Pipeline, Flow, Hydraulics, Water hammer, Corrosion, United Kingdom.

Air in pipelines can cause a variety of problems, including delays in filling, reduction in capacity, water hammer, and corrosion. Although air valves invariably supply the solution to these problems, finding the right valve for the right situation is sometimes difficult. British valve manufacturers Glenfield and Kennedy produce three basic types of air valves, each designed for specific applications. A small orifice valve is designed to release air which has come out of solution in the system during pressurized operation. Air collecting in the valve body depresses the water level until buoyancy is lost and the float falls away from the outlet orifice, releasing the air. These valves are suitable for situations in which air becomes trapped due to the upward gradient decreasing or the downward gradient increasing. A large orifice valve is designed to allow amounts of air to exhaust from the pipeline during the initial filling and to permit free entry of air during emptying. A cylindrical or spherical float in this valve remains open during filling or emptying, closing only when water rises into the valve body. Two forms of a double orifice valve are also available. The first has a large orifice unit forming the main assembly, with an attached

small orifice unit and no integral isolation valve, while the second comproses a valve built around a central screwdown isolating valve which has the small and large units disposed around it. These valves are suitable for use in horizontal sections or in pipelines with only very slight gradients. (Carroll-FRC)
W83-03249

CENTRIFUGAL PUMP BASICS,
Allis-Chalmers Corp., Cincinnati, OH. Industrial Pump Div.
W. W. French.
Water/Engineering and Management, Vol 129, No 13, p 33-35, December, 1982. 5 Fig.

Descriptors: *Pumps, *Mechanical equipment, Engineering, Centrifugal pumps, Pumping.

A description of the workings of the centrifugal pump is offered. Such a pump uses centrifugal force to move a liquid from one point to another by creating pressure. This force may be used to pump any liquid that will flow. With reference to operating principle, centrifugal pumps fall into three general classes: radial flow, mixed flow and axial flow. The main parts of the pump include the impeller, wear rings, shaft bearings, casing and the stuffing box. For optimum shaft life, and the following conditions should be considered at the time the pump is selected: corrosive nature of the fluid being pumped, operating range with respect to the best efficiency point, and the alignment of the pump and driver. A listing of nomenclature for centrifugal pumps is included. (Baker-FRC)
W83-03258

WIND ENERGY FOR LOW HEAD IRRIGATION,
South Dakota State Univ., Brookings. Water Resources Research Inst.
J. L. Wiersma, and A. R. Bender.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-220558, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, April 1983. 36 p, 10 Fig, 6 Tab. OWRT B-062-SDAK(1), 14-34-0001-0278.

Descriptors: *Pumps, Trees, *Irrigation, Winds, Energy, *Shelterbelts, Specialty crops, Low head irrigation, Air compressors, Wind turbines.

An air compressor driven by a wind turbine can be used to operate an air lift water pump. In locations where a shallow aquifer yields a limited quantity of water per unit of time, it is a successful economical method of pumping water for the irrigation of a crop that does not have a critical period of water demand. The amount of submergence of the pumping unit is critical. The efficiency of the system increases as the submergence increases. The efficiency is also dependent upon the proper sizing of the eductor tube. The factors determining the size include submergence, pressure of compressed air, quantity of compressed air available, amount of water lift, and quantity of water required. The rate of air introduced to the eductor tube must be controlled for efficient operation.
W83-03309

ENERGY RECLAMATION FROM THE DRINKING WATER SYSTEM WITH SERIES-CONNECTED PUMPS (ENERGIERUCKGEWINNUNG AUS DEM TRINKWASSERSYSTEM MIT SERIENPUMPEN),
Stuttgart Univ. (Germany, F.R.).
K. Mikus.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 2, p 52-57, February, 1981. 5 Fig, 3 Ref. English abstract.

Descriptors: *Energy sources, *Water conveyance, *Turbines, *Pumps, *Water pressure, Water distribution, Drinking water, Stuttgart, Federal Republic of Germany, Economic aspects, Hydraulic turbines, Excess pressure, Performance evaluation.

The water distribution system of the city of Stuttgart (Federal Republic of Germany) covers an area with elevation differences of 300 m and contains 56 pressure zones, requiring the release of excess pressures of 12-15 bar. Conventional methods of pressure relief (using valves) result in an irreversible transformation of pressure energy to waste heat. Traditional water turbine facilities are economical only when large quantities of hydraulic power are used. At Stuttgart, series-connected pumps are being used as turbines to reclaim energy. This system requires only a small capital outlay and small quantities of hydraulic power. A pump can be transformed into a turbine by reversing both the direction of rotation and the poles on the electric motor. A pump used as a turbine is usually at least as efficient, sometimes even more effective as when it runs as a pump, especially in overload, when efficiency declines less steeply for the turbine mode of operation. The pump as turbine can handle a significantly greater drop height as well as a larger throughput volume than it can as a pump. When planning such a system, points to be considered include the necessity of converting pump data to turbine data, the fact that the system can also run with back pressure on the suction side, and the necessity of providing a device to divert the water in the case of breakdown or overload. (Gish-FRC)
W83-03460

8D. Soil Mechanics

DETERMINATION OF THE PARAMETERS OF LARGE UNLINED CANALS ON THE BASIS OF HYDROLOGICOMORPHOLOGICAL ANALOGY,
V. I. Antropovskii.
Hydrotechnical Construction, Vol 15, No 10, p 618-622, 1981/1982, 3 Fig, 3 Tab, 9 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 10, p 37-40, October, 1981.

Descriptors: *Canal design, *Channel morphology, *Soil stability, Design criteria, Channel erosion, Erosion control, Open channels, Stable channels, Cohesionless soils, Soil mechanics, *USSR, Irtysh River.

The optimal parameters of large unlined canals may be determined by an analogy between the hydrological and morphological characteristics of natural rivers and canals. A graph relates the canal slope to the water discharge and characteristics of the underlying soils. Equations are given for three groups of soils: pebbles, gravels and coarse sands; finer sands and loams; and loamy sands, silt, and loess. The average flow velocity in the cross section of the planned canal may also be obtained from the graph, knowing discharge and canal slope. The size and shape of canal cross sections may also be determined by analogy to river stretches with considerable streamflow regulation. This is illustrated in a design channel based on a stretch of the Irtysh River from Lake Zaisan to Malaya Krasnoyarska village, USSR. Dimensions of the cross section obtained by this method were similar to those obtained by hydraulic methods. (Cassar-FRC)
W83-03197

EVALUATING THE RELIABILITY OF EARTH DAMS ACCORDING TO THE SECOND GROUP OF LIMIT STATES (METHOD OF PREDICTING DAM BEHAVIOR),
G. Ya. Bulatov.
Hydrotechnical Construction, Vol 15, No 10, p 598-603, 1981/1982. 2 Fig, 14 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 10, p 26-28, October, 1981.

Descriptors: *Dam stability, *Seepage, *Cracks, Dam failure, Earth dams, Flow resistance, USSR.

A method for predicting the stability of earth dams is based on summation of resistances along the path of a concentrated seepage flow (fictitious pipe). When cracks occur in the core in which flow velocity exceeds the level of non-eroding velocities, the core material is reworked, and the crack cavity fills with coarse material (upstream andd adjacent to the core) under certain conditions . This is illustrated in the example of the 20 m high Boulderhead Dam. Calculations indicated failure from a crack in the core, which was confirmed by an inspection. Very large, uneven settlements in a 75 m high dam were predicted to be self-healing, with formation of a plug at the contact with the filter. This behavior has been confirmed by observation. The dam is functioning normally. (Cassar-FRC)
W83-03218

8G. Materials

PLASTIC TANKS: PITFALLS TO AVOID,
Forbes (Kenneth) (Plastics) Ltd., Downham Market (England).
L. Forbes.
Water and Waste Treatment, Vol 25, No 8, p 18-19, August, 1982. 2 Fig.

Descriptors: *Construction, *Tanks, *Wastewater treatment, *Water storage, Storage, Plastic, Construction materials, Design criteria, Cost analysis.

There are many advantages to using plastic tanks in the water industry providing one is very careful in selecting a reputable fabricator who has long term experience on design, manufacture and application. In most cases there is no more cost effective alternative to the all plastic tank. It is paramount that careful design parameters be maintained, especially in view of the time-related 'creep' properties of plastics under load. The vertical cylindrical configuration proves to be far the most economical approach to design. Always insist that the tank be fully designed and, where applicable, conform in every aspect to British Standard 4994-1973. All design calculations must be available at the time fo ordering. One should insist on either seeing a similar tank which has been in a similar duty for a period of years or alternatively speaking to an end user with similar long term experience. Beware of short specification and exceptionally low cost compared to other quotations. Ensure that the supplier can construct tanks in a variety of plastic materials. The quality control system should be considered, and work must be carried out by fully tested and certified fabricators. A long term guarantee of the product against defective workmanship, design or materials must be supplied. Dangerous reagent chemicals must be stored in tanks which are to the specifications laid down by the major chemical suppliers. (Baker-FRC)
W83-03250

8I. Fisheries Engineering

EFFICIENT UTILIZATION OF INDUSTRIAL WASTER AND WASTE HEAT FOR INTENSIVE FISH PRODUCTION (DIE RATIONELLE NUTZUNG VON INDUSTRIEWASSER UND ABWARME FUR EINE INTENSIVE FISCHPRODUKTION),
VEB Binnenfischerei, Wermsdorf (German D.R.).
For primary bibliographic entry see Field 3C.
W83-03221

AQUACULTURE TECHNIQUES: A PRODUCTION FORECASTING MODEL FOR AQUACULTURE SYSTEMS,
Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
P. C. Downey, and G. W. Klontz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-221713, Price codes: A05 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Moscow, March 1983. 78 p, 7 Fig, 4 Tab, 112 Ref, 1 Append. OWRT A-063-IDA(2), 14-34-0001-0216.

Descriptors: Instream flows, Salmonids, Rainbow trout, Oxygen concentrations, *Aqua culture, *Model studies, *Fish production forecasting.

Computer implementation of the mathematical models of quantitative relationships in aquaculture systems is a dynamic process which provides a

conceptual framework for understanding systems behavior. These models can provide useful information on variable significance to systems functioning, thereby directing research resources into areas which will most benefit further understanding of the system. Furthermore, as aquaculture systems research progresses, the composite model can be modified to incorporate new technology. Modeling, therefore, is a cyclic process--a means for understanding the system, for evaluating the system, and for using the model to incorporate the new technology. This computer-implemented mathematical model addresses one of the significant limitations of aquaculture systems management, namely, production forecasting, by providing a method of using current technology to predict Allowable Growth Rate (AGR). The use of the model in aqua-culture operations could aid production forecasting, resulting in more efficient water usage and profitable aquaculture systems operations.
W83-03318

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

A CENTER FOR THE TRANSFER OF DESALINATION TECHNOLOGY,
Fairleigh Dickinson Univ., Teaneck, NJ. Coll. of Science and Engineering.
For primary bibliographic entry see Field 3A.
W83-03352

10. SCIENTIFIC AND TECHNICAL INFORMATION

10F. Preparation Of Reviews

AGRICULTURAL IRRIGATION TECHNOLOGY TRANSFER ASSESSMENT,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 3F.
W83-03281

SUBJECT INDEX

AAUATIC WEED CONTROL
Aquatic Plant Control and Disappearance of Terbutryn from Treated Waters in Ontario, Canada, 1974-1977,
W83-03166 4A

ABSORBENTS
Organic Absorbents for Triple Point Absorption Freeze Crystallization Processes,
W83-03341 3A

ACETYLENE REDUCTION
In Situ Nitrogen (C2H2) Fixation in Lakes of Southerm Victoria Land, Antarctica,
W83-03203 2H

ACID MINE DRAINAGE
Post-Mining Neutralization of Acidic Surface Mine Lakes,
W83-03278 5B

ACID RAIN
Buffer Capacities of Fresh Water Lakes Sensitive to Acid Rain Deposition,
W83-03171 2H

The Potential for Acid Precipitation Damage to Lakes of the Sierra Nevada, California,
W83-03182 5B

Effects of Simulated Acid Rain on Yields of Raphanus Sativus, Lactuca Sativa, Triticum Aestivum and Medicago Sativa,
W83-03195 5C

Effects of Coal Burning in New Mexico on Air Quality and Surface Water Quality: Raton Study Area,
W83-03382 2K

ACID SOILS
A Computer Model for Predicting the Impact of Irrigating with Saline Water on Soils and Runoff Water in Missouri,
W83-03284 3C

ACTIVATED CARBON
Removal of Trace Chlorinated Organic Compounds by Activated Carbon and Fixed-Film Bacteria,
W83-03194 5D

Trihalomethane Removal and Formation Mechanism in Water,
W83-03430 5F

ACTIVATED SLUDGE PROCESS
The Removal of Salmonella Enteritidis in Activated Sludge,
W83-03152 5D

Wastewater Treatment in Rural Areas. There Doesn't Always Have to be a Central Wastewater Treatment Facility (Abwasserreinigung Im Lanlichen Raum. Es Muss Nicht Immer Eine Zentralklaranlage Sein).
W83-03435 5D

New Design Guidelines for Vertical-Current Final Settling Tanks for Activated Sludge Plants (Neue Bemessungs-Grundlagen Fur Vertikal Durchstromite Nachklarkecken Von Belebungsanlagen),
W83-03437 5D

Anaerobic Activated Sludge Treatment of Filtrates From Thermally Conditioned Sludges (Die Behandling Von Filtratwassern Thermisch Konditionierter Schlamme Nach Anaeroben Belebunsverfahren),
W83-03440 5D

ACTIVATED SLUDGE TREATMENT
Biological Wastewater Purification with Technical Oxygen (Biologische Abwasserreinigung Mit Techn. Reinem Sauerstoff),
W83-03443 5D

ADMINISTRATION
Water Industry Accountability Through the Ombudsman System,
W83-03233 6E

ADSORPTION
Evaluating the Release of Soluble Components from Sediment,
W83-03168 5B

Free Ionic Nickel Accumulation and Localization in the Freshwater Zooplankter, Daphnia Magna,
W83-03256 5B

ADVANCED WASTEWATER TREATMENT
Advanced Wastewater Treatment by Ion Exchange,
W83-03196 5D

AERATION
Artificial Destratification to Prevent Winterkill,
W83-03299 5G

AERIAL PHOTOGRAPHY
Forecasting Methods in the Future Supply Area of the Rheintal Water Transmission Network (Beweissicherungsverfahren Im Kunftigen Wassergewinnungsgebiet Des Zweckverbands Fernwasserversorgung Rheintal (FWR),
W83-03456 3F

AGREGRATION
Aggregation of Collodial Iron During Estuarine Mixing: Kinetics, Mechanism, and Seasonality,
W83-03450 2L

AGRICULTURAL IRRIGATION
Agricultural Irrigation Technology Transfer Assessment,
W83-03281 3F

AGRICULTURAL RUNOFF
Effect of Aquatic Macrophytes on Physico-Chemical Parameters of Agricultural Drainage Water,
W83-03153 5G

The Extent and Nature of Rainfall-Soil Interaction in the Release of Soluble Chemicals to Runoff,
W83-03170 5B

Effects of Surface Application of Dairy Manure on the Infiltration Rate and Quality of Surface Runoff,
W83-03344 5B

AGRICULTURAL USE
Irrigation Water Response Function Estimation: An Improved Ridge Regression Methodology,
W83-03302 6D

AGRICULTURAL WATERSHEDS
Influence of Agricultural Drainage on Water Quality,
W83-03289 5B

Agricultural Stream Ecosystems: Structure and Function for Understanding Water Quality Improvements,
W83-03377 6G

AIR VALVES
Keeping the Flow Smooth.
W83-03249 8C

ALABAMA
The Escatawpa River - An Interstate Approach to Water Resource Management,
W83-03354 6E

ALASKA
Calving Speed of Alaska Tidewater Glaciers, With Application to Columbia Glacier,
W83-03358 2C

ALGAE
In Situ Nitrogen (C2H2) Fixation in Lakes of Southerm Victoria Land, Antarctica,
W83-03203 2H

The Influence of Micro-Algae on the Oxygen Dynamics in a Brackish Ditch,
W83-03215 5C

Lagoon Algae and the BOD Test,
W83-03400 5A

A Methodology for Algal Population Study of Periphyton: Measurement of Covering Rate (Une Methodologie Pour L Etude Des Populations Algales Du Periphyton: La Mesure Du Taux De Recouvrement),
W83-03407 5A

Nutrient Contents and Algal Growth in an Impounded River: Effects on Oxygen Balance and need for Nutrient Retention (Nahrstoffgehalte und Algenwachstum in Einem Gestauten Fluss, Auswirkungen Auf Die Sauerstoffbilanz Und Notwendigkeit Des Nahrstoffruckhaltes),
W83-03454 5C

Use of Polyethylene Imines in Flotation and Improving the Filtration of Suspensions of Blue-Green Algae,
W83-03471 5F

ALGAL CONTROL
The Biological Regulation of Bloom-Causing Blue-Green Algae: A Feasible Alternative,
W83-03311 5C

Control of Algal Dominance Through Changes in Zooplankton Grazing, Lake Washington: Phase I,
W83-03467 5G

ALGORITHMS
Quantitative Models and Analysis of Urban Nonpoint Source Water Pollution Control Systems,
W83-03184 6A

ALKALINITY
Buffer Capacities of Fresh Water Lakes Sensitive to Acid Rain Deposition,
W83-03171 2H

ALTERNATIVE USE
Economic Impacts of Transferring Water From Agriculture to Alternative Uses in Colorado,
W83-03303 6D

ALUM SLUDGE
Mother Nature as Sludge Thickener,
W83-03227 5F

AMMONIA
The Uptake of Dissolved Nitrogenous Nutrients by Lake Kinneret (Israel) Microplankton,
W83-03260 2H

ANADROMOUS FISH
Large Organic Debris and Anadromous Fish Habitat in the Coastal Redwood Environment: The Hydrologic System,
W83-03335 2E

ANAEROBIC CONDITIONS
Saline Seepage and Vertical Distribution of Oxygen in a Brackish Ditch,
W83-03216 5C

Use of Anaerobic Digestion in the Agricultural and Food Industries (Application De La Degestion Anaerobie Dans Les Industries Agro-Alimentaires),
W83-03252 5D

Selenium in Reducing Waters,
W83-03266 5B

ANAEROBIC DIGESTION
Management of Human Excreta,
W83-03191 5D

Use of Anaerobic Digestion in the Agricultural and Food Industries (Application De La Degestion Anaerobie Dans Les Industries Agro-Alimentaires),
W83-03252 5D

Anaerobic Activated Sludge Treatment of Filtrates From Thermally Conditioned Sludges (Die Behandling Von Filtratwassern Thermisch Konditionierter Schlamme Nach Anaeroben Belebunsverfahren),
W83-03440 5D

ANIMAL WASTES
Horses in Suburbia,
W83-03176 5G

Effects of Surface Application of Dairy Manure on the Infiltration Rate and Quality of Surface Runoff,
W83-03344 5B

Fecal Coliform Release Studies and Development of a Preliminary Nonpoint Source Transport Model for Indicator Bacteria,
W83-03376 5B

ANTARCTICA
In Situ Nitrogen (C2H2) Fixation in Lakes of Southerm Victoria Land, Antarctica,
W83-03203 2H

ANTIFOULANTS
The Fate of Antifoulant Organotin Compounds in Water Systems,
W83-03315 5B

APPROPRIATION
Adapting Appropriation Water Law to Accommodate Equitable Consideration of Instream Flow Uses,
W83-03379 6E

New Mexico Water Law: An Overview and Discussion of Current Issues,
W83-03492 6E

AQUA CULTURE
Aquaculture Techniques: A Production Forecasting Model for Aquaculture Systems,
W83-03318 8I

AQUACULTURE
Efficient Utilization of Industrial Waster and Waste Heat for Intensive Fish Production (Die Rationelle Nutzung Von Industriewasser Und Abwarme Fur Eine Intensive Fischproduktion),
W83-03221 3C

An Evaluation of Proposed Cage Fish Culture on Loch Lomond, An Important Reservoir in Central Scotland,
W83-03403 6G

AQUATIC ANIMALS
Species Composition and Distribution of the Macrozoobenthos of the Maritsa River (Vidov Sustav I Razpredelenie Na Makrozoobentosa Ot Reka Maritsa),
W83-03474 5C

AQUATIC BACTERIA
Diel Changes in Numbers and Activities of Bacterioplankton in a Reservoir in Relation to Algal Production,
W83-03263 2H

AQUATIC ENVIRONMENT
An Experimental Investigation of the Effects of Crude Oil on Two Freshwater Lake Ecosystems,
W83-03273 5C

AQUATIC HABITATS
Large Organic Debris and Anadromous Fish Habitat in the Coastal Redwood Environment: The Hydrologic System,
W83-03335 2E

AQUATIC PLANT GROWTH
A Study of Eutrophication and Aquatic Plants Growths in Selected Lakes and Rivers of Puerto Rico,
W83-03300 5C

AQUATIC PLANTS
Fate of Nitrogen and Phosphorus in a Waste-Water Retention Reservoir Containing Aquatic Macrophytes,
W83-03154 5D

AQUATIC PRODUCTIVITY
Tendencies in the Changes in the Saprobic Conditions of the Maritsa River (Tendentsii V Izmenenyata Na Saprobiolodgichnoto Sustoyanie Na Reka Maritsa),
W83-03473 5C

Species Composition and Distribution of the Macrozoobenthos of the Maritsa River (Vidov Sustav I Razpredelenie Na Makrozoobentosa Ot Reka Maritsa),
W83-03474 5C

The Species Deficit of the Macrozoobenthic Communities as a Criterion for the Transsaprobic Influences on the Maritsa River (Vidoviyat Defitsit Na Makrozoobentosnite Suobshchestva Kato Kriterii Za Transsaprobnite Vliyaniya Vurkhu Reka Maritsa),
W83-03475 5C

AQUATIC WEED CONTROL
Effect of Hydout and Aquathol K on Hydrilla in Gatun Lake, Panama,
W83-03162 4A

Threshold 2,4-D Concentrations for Control of Eurasian Watermilfoil and Sago Pondweed,
W83-03163 4A

Effects of Simazine Treatment on Channel Catfish Production and Water Quality in Ponds,
W83-03167 5G

Investigation Into Effective Control Methods for Brazilian Elodea (Egeria Densa Planchon) in Lake Marion, S.C.,
W83-03433 4A

AQUIFER MANAGEMENT
Investigative Programs for Designing and Modeling Mine Water Control Systems,
W83-03265 4B

AQUIFER MODELS
Effects of Groundwater Pumpage on Surface and Groundwater Flows on Adjoining Basins,
W83-03431 4B

AQUIFERS
The Groundwater Budget of Lake Wingra, Dane County, Wisconsin,
W83-03305 2F

Texas Groundwater Law: A Survey and Some Proposals,
W83-03497 6E

ARIZONA
Water Plant Grows Bigger, Cuts Electric Bill.
W83-03226 5F

Field Rating Evaluation of a Large Supercritical Measurement Flume,
W83-03239 7B

Effects of Groundwater Pumpage on Surface and Groundwater Flows on Adjoining Basins,
W83-03431 4B

ARKANSAS
The Costs and Benefits of Soil Erosion Control in the North Lake Chicot Watershed,
W83-03331 4D

Effects of Sewage Pollution in the White River, Arkansas on Benthos and Leaf Detritus Decomposition,
W83-03332 5C

Monitoring of Groundwater Levels for Real-Time Conjunctive Water Management,
W83-03333 7B

Evaluation and Accessing of Data for a Water Resources Simulator,
W83-03334 7A

Expansion Potential for Irrigation Within the Mississippi Delta Region,
W83-03345 6B

Causes of Localized Copper Corrosion in Drinking Water Supplies,
W83-03346 5F

AROMATIC COMPOUNDS
Biodegradation of 1,3-Dinitrobenzene,
W83-03155 5B

ARTESIAN AQUIFERS
An Economic Analysis of Obstacles to Water Conservation in Montana Water Law,
W83-03464 4B

ARTHROPODS
The Effect of Hormonal Pollutants on Aquatic Crustacea and the Surrounding Environment,
W83-03314 5C

ATMOSPHERIS PHYSICS
Numerical Simulation of Land-Breeze-Induced Snowbands Along the Western Shore of Lake Michigan,
W83-03482 2C

ATRAZINE
The Responses of Plankton Communities in Experimental Ponds to Atrazine, the Most Heavily Used Pesticide in the United States,
W83-03255 5C

AUFWUCHS
The Effect of Aufwuchs Copper on Spat Settlement of the Oyster, Crassostrea Virginica,
W83-03429 5C

AUSTRALIA
Lead and Other Trace Metals in the Sediments and Selected Biota of Princess Royal Harbour, Albany, Western Australia,
W83-03399 5B

AUTOCLAVES
On the Analysis of Trace Elements Harmful to Humans in River Sediments (Zur Analytik Humangefahrlicher Spurenelemente in Flusssediment),
W83-03442 5A

AUTOMATION
Valves, Penstocks and Actuators: Reliable Control of Water Systems,
W83-03245 5F

Topical Questions on Central Control and Monitoring for Water Supplies (Aktuelle Fragen Bei Zentraler Steuerung Und Uberwachung Von Wasserversorgungen),
W83-03449 5F

Automation in Wastewater Technology and Water Quality. Practical Experience with Control, Regulation, and Automation in Sewer Systems, Wastewater Treatment, and Water Quality Control (Automation in Der Abwassertechnik und Gewassergute. Praktische Erfahrungen Bei Der Steuerung, Regelung und Automation Bei

Der Abwasserableitung, Abwasserbehandlung und Gewasserguteuberwachung,
W83-03469 5D

AVAILABLE WATER
Forecasting Methods in the Future Supply Area of the Rheintal Water Transmission Network (Beweissicherungsverfahren Im Kunftigen Wassergewinnungsgebiet Des Zweckverbands Fernwasserversorgung Rheintal (FWR),
W83-03456 3F

Water Availability in the New Mexico Upper Rio Grande Basin to the Year 2000,
W83-03493 6D

BACKWATER CURVE
Backwater Curve Computations Under Ice Covers in the La Grande River (Courbes De Remous Sous Les Couverts De Glace De La Grande Riviere),
W83-03395 2C

BACTERIA
Removal of Trace Chlorinated Organic Compounds by Activated Carbon and Fixed-Film Bacteria,
W83-03194 5D

New Approaches to Measuring Total Bacterial Populations in Water Supplies,
W83-03292 5A

Fecal Coliform Release Studies and Development of a Preliminary Nonpoint Source Transport Model for Indicator Bacteria,
W83-03376 5B

Relationships Among the Bacteria Indicators of Fecal Pollution in the Water of the River Brenta (Relazioni Tra Gli Indicatori Di Inquinamento Fecale Nelle Acque Del Fiume Brenta)
W83-03485 5A

BACTERIAL ANALYSIS
Effect of Sunlight on Enumeration of Indicator Bacteria Under Field Conditions,
W83-03291 5A

BACTERIOPHAGE
Applications of a Serratia Marcescens Bacteriophage as a New Microbial Tracer of Aqueous Environments,
W83-03165 5B

BATCH CULTURE
Chemostat Adaptation of Escherichia Coli B/r/ 1 to Low Water Activity,
W83-03151 5D

BATHYMETRY
Calving Speed of Alaska Tidewater Glaciers, With Application to Columbia Glacier,
W83-03358 2C

BELIGIUM
Ecological Assessment of Water Quality: Comparison of Biological-Ecological Procedures in a Rain-Fed Lowland Waterway (Kleine Nete, N. Belgium),
W83-03214 5C

BENEFITS
Estimation of the Economic Worth of Water for Release Decisions,
W83-03280 6A

Worth of Inflow Forecast for Reservoir Operation,
W83-03296 4A

BENTHIC FAUNA
Zoobenthos of Lakes of Black Sea Reservation (Preserve),
W83-03479 2H

BENTHOS
Production of Invertebrates in the Tidewater Zone of a Coastal River and Adjacent Estuary,
W83-03183 2L

Particulate Matter Resuspension Via Metabolically Produced Gas Bubbles From Benthic Estuarine Microalgae Communities,
W83-03261 2L

Effects of Sewage Pollution in the White River, Arkansas on Benthos and Leaf Detritus Decomposition,
W83-03332 5C

BERLIN
Berlin Water '81 -- 125 Years of Central Water Distribution (Wasser Berlin '81 -- 125 Jahre Zentrale Wasserversorgung),
W83-03455 5F

BIOASSAY
Development of a Cell Culture Screen for Water Toxicity,
W83-03306 5A

The Biota of Oklahoma Springs: Natural Biological Monitoring of Groundwater Quality,
W83-03347 2H

BIOCHEMICAL OXYGEN DEMAND
Lagoon Algae and the BOD Test,
W83-03400 5A

BIOCHEMICAL TESTS
Development of a Cell Culture Screen for Water Toxicity,
W83-03306 5A

BIODEGRADATION
Biodegradation of 1,3-Dinitrobenzene,
W83-03155 5B

Use of Anaerobic Digestion in the Agricultural and Food Industries (Application De La Degestion Anaerobie Dans Les Industries Agro-Alimentaires),
W83-03252 5D

BIOINDICATORS
Applications of a Serratia Marcescens Bacteriophage as a New Microbial Tracer of Aqueous Environments,
W83-03165 5B

Effect of Sunlight on Enumeration of Indicator Bacteria Under Field Conditions,
W83-03291 5A

The Biota of Oklahoma Springs: Natural Biological Monitoring of Groundwater Quality,
W83-03347 2H

Relationships Among the Bacteria Indicators of Fecal Pollution in the Water of the River Brenta (Relazioni Tra Gli Indicatori Di Inquinamento Fecale Nelle Acque Del Fiume Brenta)
W83-03485 5A

BIOLOGICAL PROPERTIES
Ecological Assessment of Water Quality: Comparison of Biological-Ecological Procedures in a Rain-Fed Lowland Waterway (Kleine Nete, N. Belgium),
W83-03214 5C

BIOLOGICAL TREATMENT
Problems of the Load at Veb Zellstoff-Und Papierfabrik Rosenthal (Probleme Der Abwasserlast Im Veb Zellstoff-Und Papierfabrik Rosenthal),
W83-03223 5D

BIOMASS
Chesapeake Bay Nutrient and Plankton Dynamics. 1. Bacterial Biomass and Production During Spring Tidal Destratification in the York River, Virginia, Estuary,
W83-03264 2L

Investigation Into Effective Control Methods for Brazilian Elodea (Egeria Densa Planchon) in Lake Marion, S.C.,
W83-03433 4A

BIRDS
Industrial Effluents as a Source of Mercury Contamination in Terrestrial Riparian Vertebrates,
W83-03402 5B

BLEACHING WASTES
Problems of the Load at Veb Zellstoff-Und Papierfabrik Rosenthal (Probleme Der Abwasserlast Im Veb Zellstoff-Und Papierfabrik Rosenthal),
W83-03223 5D

BOILER WATER
Water Management for Packaged Boiler Systems,
W83-03205 5F

BOTTOM SAMPLING
Chemical-Quality Reconnaissance of the Water and Surficial Bed Material in the Delaware River Estuary and Adjacent New Jersey Tributaries, 1980-81,
W83-03363 2L

BOTTOM SEDIMENTS
Assessing Enviromental Impacts of Open Water Disposal of Dredged Sediment,
W83-03251 6G

Chemical-Quality Reconnaissance of the Water and Surficial Bed Material in the Delaware River Estuary and Adjacent New Jersey Tributaries, 1980-81,
W83-03363 2L

BOUNDARY PROCESSES
Johnstown-Western Pennsylvania Storm and Floods of July 19-20, 1977,
W83-03357 2E

BRAZIL
Building Brazil's Nova Avanhandava Dam,
W83-03253 8A

BRAZILIAN ELODEA
Investigation Into Effective Control Methods for Brazilian Elodea (Egeria Densa Planchon) in Lake Marion, S.C.,
W83-03433 4A

BRITISH COLUMBIA
Water and Sewer System Modelling Using a Micro-Computer System,
W83-03243 5F

Selenium in Reducing Waters,
W83-03266 5B

Evaluation and Monitoring of the Hydrologic Impact of Cabin Creek, B.C. Coal Pit Mining on the North Fork of the Flathead River,
W83-03325 6G

BROMIDES
Control of Trihalomethanes in Barcelona's Water Supply (Controle Des Trihalomethanes Dans Les Eaux D'Approvisionnement De Barcelone),
W83-03210 5B

BUFFER CAPACITY
Buffer Capacities of Fresh Water Lakes Sensitive to Acid Rain Deposition,
W83-03171 2H

BULGARIA
Tendencies in the Changes in the Saprobic Conditions of the Maritsa River (Tendentsii V Iz-

menenyata Na Saprobiolodgichnoto Sustoyanie Na Reka Maritsa),
W83-03473 5C

Species Composition and Distribution of the Macrozoobenthos of the Maritsa River (Vidov Sustav I Razpredelenie Na Makrozoobentosa Ot Reka Maritsa),
W83-03474 5C

The Species Deficit of the Macrozoobenthic Communities as a Criterion for the Transsaprobic Influences on the Maritsa River (Vidoviyat Defitsit Na Makrozoobentosnite Suobshchestva Kato Kriterii Za Transsaprobnite Vliyaniya Vurkhu Reka Maritsa),
W83-03475 5C

CALCITE
The Efficacy of Removal of Heavy Metals from Water by Calcite,
W83-03157 5F

CALIBRATIONS
On The Esimation of the Error of Soil Moisture Measurement by Means of a Neutron Scattering Probe (Zur Abschatzung Des Fehlers Der Bodenfeuchte-Messung Mit Einer Neutronensonde),
W83-03242 7B

Response Surface Parameter Sensitivity Analysis Methods for Postcalibration Studies,
W83-03293 2A

CALIFORNIA
The Potential for Acid Precipitation Damage to Lakes of the Sierra Nevada, California,
W83-03182 5B

Soil Collapses on Shores of Clear Lake Reservoir, Modoc County, California,
W83-03189 8A

The Evolution of California State Water Planning 1850-1928,
W83-03274 6E

Worth of Inflow Forecast for Reservoir Operation,
W83-03296 4A

Large Organic Debris and Anadromous Fish Habitat in the Coastal Redwood Environment: The Hydrologic System,
W83-03335 2E

California Groundwater Management: The Sacred and the Profane,
W83-03498 6E

CANADA
Citizen Participation in the Design and Management of Reservoirs,
W83-03418 6A

The Evolution of Public Involvement in Reservoir Developments in Canada,
W83-03421 6G

CANAL DESIGN
Fluid Mechanics - The Green Function of the Neumann-Kelvin Problem in a Canal,
W83-03188 8B

Determination of the Parameters of Large Unlined Canals on the Basis of Hydrologicomorphological Analogy,
W83-03197 8D

CAPITAL COSTS
Costs of Phosphate Elimination in Municipal Wastewater Facilities (Kosten Der Phosphatelimination in Kommunalen Klaranlagen),
W83-03436 5D

CARBOHYDRATES
Investigation Into Effective Control Methods for Brazilian Elodea (Egeria Densa Planchon) in Lake Marion, S.C.,
W83-03433 4A

CARBON RADIOISOTOPES
Methodologies for Extraction of Dissolved Inorganic Carbon for Stable Carbon Isotope Studies: Evaluation and Alternatives,
W83-03359 2K

Environmental Isotopic and Hydrogeochemical Investigation of Recharge and Subsurface Flow in Eagle Valley, Nevada,
W83-03380 2F

Investigation Into Effective Control Methods for Brazilian Elodea (Egeria Densa Planchon) in Lake Marion, S.C.,
W83-03433 4A

CARBONATES
The Role of Fulvic Substances on Trace Metal Partitioning in Natural Aquatic Sediments,
W83-03348 2K

CATFISH FARMING
Effects of Simazine Treatment on Channel Catfish Production and Water Quality in Ponds,
W83-03167 5G

CATIONIC SURFACTANTS
The Role of Cationic Surfactants in the Renovation of Water,
W83-03275 5F

CAVES
Geohydrology of the Rio Camuy Cave System, Puerto Rico,
W83-03283 2F

CENTER-PIVOT IRRIGATION
Water and Energy Conservation Using Center Pivot Irrigation and Reduced Tillage Systems,
W83-03342 3F

CERTAINTY EQUIVALENT
Real-Time Forecasting of River Flows and Stochastic Optimal Control of Multireservoir Systems,
W83-03323 4A

CHANNEL IMPROVEMENT
A 'Before and After' Study of the Effects of Land Drainage Works on Fish Stocks in the Upper Reaches of a Lowland River,
W83-03192 6G

CHANNEL MORPHOLOGY
Determination of the Parameters of Large Unlined Canals on the Basis of Hydrologicomorphological Analogy,
W83-03197 8D

CHANNELS
The Construction and Operation of an Articulated Laboratory Flow Channel,
W83-03230 8B

CHEMICAL ANALYSIS
Hygienic Evaluation of Hydrogen Sulfide-Containing Thermal Waters Used in Hot Water Supply Systems (Gigiena Otsenka Serovodnykh Termal'Nykh Vod, Ispol'Zuemykh V Sisteme Goryachego Vodosnabzheniya),
W83-03405 5C

Application of Kelgraph to Electrochemical Detectors for Flow Injection Analysis and High Performance Liquid Chromatography,
W83-03490 5A

CHEMICAL COMPOSITION
Composition of Estuarine Colloidal Material: Organic Components,
W83-03202 2L

CHEMICAL OXYGEN DEMAND
Anaerobic Activated Sludge Treatment of Filtrates From Thermally Conditioned Sludges (Die Behandling Von Filtratwassern Thermisch Konditionierter Schlamme Nach Anaeroben Belebunsverfahren),
W83-03440 5D

CHEMICAL PRECIPITATION
Effect of Precipitation Purification on the Behavior of Sludges During Mechanical Dewatering (Einfluss Der Fallungsreinigung Auf Das Verhalten Von Klarschlammen Bei Der Mechanischen Entwasserung),
W83-03444 5D

CHEMICAL REACTIONS
Photoinduced Hydroxylation Reactions of Organic Chemicals in Natural Waters, Nitrates as Potential OH Radical Sources (Photoinduzierte Hydroxylierungsreaktionen Organischer Chemikalien in Naturlichen Gewassern, Nitrate Als Potentielle Oh-Radikalquellen),
W83-03385 5B

CHEMICAL STRATIFICATION
Meromixis in an Equatorial African Soda Lake,
W83-03254 2H

CHEMICAL WASTES
Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho--Emphasis: 1974-1978,
W83-03365 5B

Organics Transported Through Selected Geologic Media: Assessment of Organics Transported Away From Industrial Waste Disposal Sites,
W83-03375 5A

CHEMISTRY OF PRECIPITATION
The Potential for Acid Precipitation Damage to Lakes of the Sierra Nevada, California,
W83-03182 5B

CHEMOCLINE
Meromixis in an Equatorial African Soda Lake,
W83-03254 2H

CHESAPEAKE BAY
The Effect of Aufwuchs Copper on Spat Settlement of the Oyster, Crassostrea Virginica,
W83-03429 5C

CHINA
Management of Human Excreta,
W83-03191 5D

CHISELLING
Tillage and Irrigation Management Practices for Optimum Crop Production,
W83-03329 3F

CHLORINATED HYDROCARBONS
Drinking Water Contamination with Chloro-Organic Compounds: Sources, Health Effects, Control (Contaminazione Delle Acque Potabili Da Composti Cloro-Organici: Origine, Effetti Biologici, Misure Di Protezione E Di Controllo),
W83-03476 5F

CHLORINATION
Groundwater Purification by Infiltration of Ozonized Water (Grundwassersanierung Durch Infiltration Von Ozontem Wasser),
W83-03200 5G

Prechlorination and Trihalomethane Formation at Water Treatment,
W83-03228 5F

Identification and Assessment of Effluent Residuals in Treated Leachate from Landfill Disposal Sites,
W83-03272 5E

A Novel Bactericidal Agent for Treatment of Water,
W83-03337 5F

CHLOROFORM
Fluorimetric Determination of Chloroform in Drinking Water,
W83-03190 5A

CHROMATOGRAPHY
Determination of the Complexing Capacity of Water Systems by Gel Chromatographic and Electrochemical Techniques,
W83-03185 5A

Molecular Size Determination of Chloroform Precursors,
W83-03187 5A

Application of Kelgraph to Electrochemical Detectors for Flow Injection Analysis and High Performance Liquid Chromatography,
W83-03490 5A

CHRONOAMPEROMETRY
Characterization of Kel-F-Graphite Composite (Kelgraf) Electrodes and Application to Detection in Flowing Streams,
W83-03369 7B

CIRCULATION PATTERNS
Comparative Study of the Causes and Effects of Recent Southeastern Droughts,
W83-03297 2B

CITIZEN PARTICIPATION
The Impact of Institutional Structure and Citizen Participation on Water Resource Planning in Western Kansas,
W83-03330 6D

Citizen Participation in the Design and Management of Reservoirs,
W83-03418 6A

CIVIL DEFENSE
Development and Status of Emergency Drinking Water Supply in the Federal Republic of Germany After Passage of the Water Safeguarding Law (Entwicklung und Stand Der Tinkwasser-Notversorgung in Der Bundesrepublik Nach Dem Wassersicherstellungsgesetz),
W83-03458 5F

CLAMS
Identification of the Water Quality Factors Which Prevent Fingernail Clams From Recolonizing the Illinois River, Phase III,
W83-03463 5C

CLASSIFICATION
Landsat Monitoring of Irrigated Farmland Acreage in Curry County, New Mexico,
W83-03310 7A

CLAYPAN SOILS
Efficient Use of Water for Irrigation in the Upper Midwest,
W83-03282 6D

CLIMATIC DATA
Contribution to the Measurement of Evaporation in Remote Stations (Beitrag Zur Verdunstungsmessung in Abgelegenen Stationen),
W83-03225 7B

Opportunities and Potential Benefits of Radar Rainfall Measurements for the Federal Republic of Germany (Moglichkeiten und Potentieller Nutzen Eines Bundesdeutschen Niederschlagsradar--Verbundsystems),
W83-03240 7B

COAGULANTS
The Role of Cationic Surfactants in the Renovation of Water,
W83-03275 5F

COAGULATION
Physiochemical Pretreatment of Landfill Leachates Using Coagulation,
W83-03172 5G

Optimization and Dynamic Control of the Coagulation Process in Water Treatment,
W83-03373 5F

COAL MINES
Evaluation and Monitoring of the Hydrologic Impact of Cabin Creek, B.C. Coal Pit Mining on the North Fork of the Flathead River,
W83-03325 6G

COAL PILE LEACHATE
Effects of Coal Pile Runoff on Stream Quality and Macro-Invertebrate Communities,
W83-03307 5C

COLIFORMS
The Movement of Nitrates, Phosphates, and Fecal Coliform Bacteria From Disposal Systems Installed in Selected Connecticut Soils,
W83-03276 5B

Fecal Coliform Release Studies and Development of a Preliminary Nonpoint Source Transport Model for Indicator Bacteria,
W83-03376 5B

Relationships Among the Bacteria Indicators of Fecal Pollution in the Water of the River Brenta (Relazioni Tra Gli Indicatori Di Inquinamento Fecale Nelle Acque Del Fiume Brenta)
W83-03485 5A

COLLAPSE
Soil Collapses on Shores of Clear Lake Reservoir, Modoc County, California,
W83-03189 8A

COLLOIDS
Composition of Estuarine Colloidal Material: Organic Components,
W83-03202 2L

Aggregation of Collodial Iron During Estuarine Mixing: Kinetics, Mechanism, and Seasonality,
W83-03450 2L

COLOR
Optimization and Dynamic Control of the Coagulation Process in Water Treatment,
W83-03373 5F

COLORADO
Regional Detection of Change in Water Quality Variables,
W83-03295 2A

Economic Impacts of Transferring Water From Agriculture to Alternative Uses in Colorado,
W83-03303 6D

Sediment Deposition Model for Reservoirs Based on the Dominant Physical Processes,
W83-03417 2J

COLUMBIA GLACIER
Calving Speed of Alaska Tidewater Glaciers, With Application to Columbia Glacier,
W83-03358 2C

COMMUNITY INFRASTRUCTURE
The Impact of Institutional Structure and Citizen Participation on Water Resource Planning in Western Kansas,
W83-03330 6D

COMPLEXING CAPACITIES
Copper(II) Complexing Capacities of Natural Waters by Fluorescence Quenching,
W83-03396 5A

COMPREHENSIVE PLANNING
Index Construction for Multiple Objective Analysis of Land and Water Use in a High Mountain Watershed,
W83-03286 6A

COMPUTER INFORMATION DELIVERY SYSTEM
On-Site Sewage Disposal: Site Suitability, System Selection and Soil Absorption Area Sizing,
W83-03268 5D

COMPUTER MODELS
Computer Simulation of Local Destratification in Reservoirs,
W83-03279 5G

Organic Absorbents for Triple Point Absorption Freeze Crystallization Processes,
W83-03341 3A

Monitoring Flocculation in Water Treatment Using a Computer-Controlled Physical Model (Uberwachung der Wasseraufbereitung Mit Hilfe Eines Rechnergesteuerten Physikalischen Modells),
W83-03439 5F

COMPUTER PROGRAMS
The Chemistry of Geothermal Waters in Iceland. I. Calculation of Aqueous Specification from 0 to 370C,
W83-03201 2K

COMPUTERS
Water and Sewer System Modelling Using a Micro-Computer System,
W83-03243 5F

Topical Questions on Central Control and Monitoring for Water Supplies (Aktuelle Fragen Bei Zentraler Steuerung Und Uberwachung Von Wasserversorgungen),
W83-03449 5F

CONDUCTIVITY
Regional Detection of Change in Water Quality Variables,
W83-03295 2A

CONNECTICUT
Horses in Suburbia,
W83-03176 5G

CONSERVATION TILLAGE
Effect of Incorporation of Fall-Applied Fertilizer on Runoff Losses of Nutrients and Soil From Soybean Ground,
W83-03298 2J

CONSTRUCTION
Modelling the Flood Alleviation Scheme for the Usk at Brecon,
W83-03247 8B

The Megget Scheme.
W83-03248 8A

Plastic Tanks: Pitfalls to Avoid,
W83-03250 8G

Building Brazil's Nova Avanhandava Dam,
W83-03253 8A

The Meaning of the Generally Accepted Technological Standards for the Planning, Construction, and Operation of Water Distribution Facilities (Die Bedeutung Der Anerkannten Regeln Der Technik Fur Planung, Bau und Betrieb Von Wasserversorgungsanlagen),
W83-03441 6E

CONSTRUCTION METHODS
Inlet Construction for Vortex Drops With Supercritical Inflow (Einlaufkonstruktion Fur Wirbelfallschachte Mit Schiessendem Zufluss),
W83-03481 8B

CONSUMPTIVE USE
Factors Influencing Hourly and Daily Water Demand (Uber Die Stunden-Und Tagewasserbedarf Beeinflussenden Faktoren),
W83-03438 6D

CONSUMPTIVE USE (WATER)
Measurement of Actual Transpiration of Native Grass Stands as a Component of Nebraska Sandhills Groundwater Hydrology,
W83-03312 2D

CONVECTION
Experimental and Analytical Study of Heat Transfer and Mixing in Thermally Stratified Buoyant Flows,
W83-03370 2H

COOLING WATER
Concentration, Reactivity and Fate of Copper, Nickel, and Zinc Associated with a Cooling-Water Plume in Estuarine Waters, II. The Particulate Phase,
W83-03398 5B

COPPER
Causes of Localized Copper Corrosion in Drinking Water Supplies,
W83-03346 5F

Copper(II) Complexing Capacities of Natural Waters by Fluorescence Quenching,
W83-03396 5A

Inverse-Voltammetry of Some Copper Chelates Using a Carbon Paste Electrode. Determination of Copper in Drinking Water by Oxidation of Copper Dithio-Oxamide (Zur Invers-Voltammetrie Einiger Kupferchelate an Der Kohlepaste-Electrode. Bestimmung Von Kupfer in Trinkwasser Durch Oxidation Von Kupferdithiooxamid),
W83-03415 5A

The Effect of Aufwuchs Copper on Spat Settlement of the Oyster, Crassostrea Virginica,
W83-03429 5C

CORRELATION ANALYSIS
Factors Influencing Hourly and Daily Water Demand (Uber Die Stunden-Und Tagewasserbedarf Beeinflussenden Faktoren),
W83-03438 6D

Promising Experiments on Leak Location by Means of Correlation (Aussichtsreiche Versuche Zur Leckortung Mittels Korrelation),
W83-03445 5F

CORROSION
Causes of Localized Copper Corrosion in Drinking Water Supplies,
W83-03346 5F

COST ANALYSIS
Parametric Study of Seawater Reverse Osmosis Desalting Plants,
W83-03316 3A

An Economic Analysis of Obstacles to Water Conservation in Montana Water Law,
W83-03464 4B

COST BENEFIT ANALYSIS
Estimation of the Economic Worth of Water for Release Decisions,
W83-03280 6A

The Costs and Benefits of Soil Erosion Control in the North Lake Chicot Watershed,
W83-03331 4D

Cost and Precision in a Stream Sampling Program,
W83-03336 6C

Expansion Potential for Irrigation Within the Mississippi Delta Region,
W83-03345 6B

Topical Questions on Central Control and Monitoring for Water Supplies (Aktuelle Fragen Bei Zentraler Steuerung Und Uberwachung Von Wasserversorgungen),
W83-03449 5F

CRACKS
Evaluating the Reliability of Earth Dams According to the Second Group of Limit States (Method of Predicting Dam Behavior),
W83-03218 8D

CROP DECISIONS
The Impact of Institutional Structure and Citizen Participation on Water Resource Planning in Western Kansas,
W83-03330 6D

CROP PRODUCTION
A Method for Applying Crop Sensitivity Factors in Irrigation Scheduling,
W83-03384 3F

Forecasting Methods in the Future Supply Area of the Rheintal Water Transmission Network (Beweissicherungsverfahren Im Kunftigen Wassergewinnungsgebiet Des Zweckverbands Fernwasserversorgung Rheintal (FWR),
W83-03456 3F

Technology Assessment of Irrigation Scheduling and Crop Response,
W83-03488 3F

Water-Its Role From Now to the Year 2000,
W83-03491 6D

CROP YIELD
Effects of Simulated Acid Rain on Yields of Raphanus Sativus, Lactuca Sativa, Triticum Aestivum and Medicago Sativa,
W83-03195 5C

Effect of Irrigation and Harvesting Dates on the Yield of Spring-Sown Sugar-Beet,
W83-03383 3F

Field Study of Actual Evapotranspiration of a Wheat Crop (Etude 'In Situ' De L'Evapotranspiration Reelle D'une Culture De Ble),
W83-03389 2D

Obtaining Soil Physical Field Data for Simulating Soil Moisture Regimes and Associated Potato Growth,
W83-03390 2G

Irrigation Water Conservation by Using Wide-Spaced Furrows,
W83-03408 3F

Forecasting Methods in the Future Supply Area of the Rheintal Water Transmission Network (Beweissicherungsverfahren Im Kunftigen Wassergewinnungsgebiet Des Zweckverbands Fernwasserversorgung Rheintal (FWR),
W83-03456 3F

CULTIVATION
Conservation of Soil, Water, andd Energy Through Reduced Tillage Systems - Phase I sub 1,
W83-03287 4D

Tillage and Irrigation Management Practices for Optimum Crop Production,
W83-03329 3F

CULTURE MEDIA
Improved Salmonella Recovery from Moderate to Highly Polluted Waters,
W83-03164 5A

CULTURING TECHNIQUES
Improved Salmonella Recovery from Moderate to Highly Polluted Waters,
W83-03164 5A

CUTTING MANAGEMENT
Effects of Silvicultural Practices on Water Quality in Northern Wisconsin,
W83-03304 5G

CYANIDE
Polarographic Determination of Low Levels of Cyanide and Metals in the Waste-Waters Discharged by an Electroplating Plant (Dosages Polarographiques de Faibles Quantities D'Ions Cyanure et de Metaux Dans Les Euax Rejetees Par un Atelier de Galvanoplastie),
W83-03412 5A

CYANOPHYTA
The Biological Regulation of Bloom-Causing Blue-Green Algae: A Feasible Alternative,
W83-03311 5C

CYCLING NUTRIENTS
Particulate Matter Resuspension Via Metabolically Produced Gas Bubbles From Benthic Estuarine Microalgae Communities,
W83-03261 2L

CZECHOSLOVAKIA
Diel Changes in Numbers and Activities of Bacterioplankton in a Reservoir in Relation to Algal Production,
W83-03263 2H

DAM EFFECTS
The Effects of Altered Hydrologic Regime on Tree Growth Along the Missouri River in North Dakota,
W83-03262 6G

Hydrobiology of the Littoral Zone of the Dnieper Estuary Under Conditions of Regulated Flow of the River,
W83-03480 6G

DAM FAILURE
Johnstown-Western Pennsylvania Storm and Floods of July 19-20, 1977,
W83-03357 2E

DAM STABILITY
Evaluating the Reliability of Earth Dams According to the Second Group of Limit States (Method of Predicting Dam Behavior),
W83-03218 8D

DAMS
Building Brazil's Nova Avanhandava Dam,
W83-03253 8A

DAPHNIA
Free Ionic Nickel Accumulation and Localization in the Freshwater Zooplankter, Daphnia Magna,
W83-03256 5B

DATA ACQUISITION
Monitoring of Groundwater Levels for Real-Time Conjunctive Water Management,
W83-03333 7B

Evaluation and Accessing of Data for a Water Resources Simulator,
W83-03334 7A

DATA COLLECTIONS
Evaluation and Accessing of Data for a Water Resources Simulator,
W83-03334 7A

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigtion. Part 3: Canadian, North Canadian, and Deep Fork River Basins through 1979,
W83-03362 7C

DECISION MAKING
The Evolution of Public Involvement in Reservoir Developments in Canada,
W83-03421 6G

A Public Participation Decision to Fill a Pacific Northwest Reservoir,
W83-03423 6D

Multi-Purpose Storage Systems: Objective, Conflicts, Alternatives,
W83-03424 6A

DECOMPOSITION
Effects of Sewage Pollution in the White River, Arkansas on Benthos and Leaf Detritus Decomposition,
W83-03332 5C

Production and Decomposition of Forest Litter Fall on the Apalachicola River Flood Plain, Florida,
W83-03364 5B

Agricultural Stream Ecosystems: Structure and Function for Understanding Water Quality Improvements,
W83-03377 6G

DEEP SEEPAGE
Basin-Scale Evapotranspiration Determination through Watershed and Climate Analyses,
W83-03328 2D

DEGRADATION
Biodegradation of 1,3-Dinitrobenzene,
W83-03155 5B

DELAWARE
Influence of Agricultural Drainage on Water Quality,
W83-03289 5B

New Approaches to Measuring Total Bacterial Populations in Water Supplies,
W83-03292 5A

DELAWARE RIVER
Chemical-Quality Reconnaissance of the Water and Surficial Bed Material in the Delaware River Estuary and Adjacent New Jersey Tributaries, 1980-81,
W83-03363 2L

DENDROGRAPHY
Automated Strain Gage Dendrography for Improved Water Utilization in Plants,
W83-03372 2I

DENMARK
A Modified Sediment Transport Model for Natural Streams,
W83-03494 2J

DEPOSITION
Sedimentologic Study of the Mouth of the Gabon River Estuary (Etude Sedimentologique De L'Embouchure De L'Estuaire Du Gabon),
W83-03257 2L

DESALINATION
Barge-Mounted Plant for Desalination: An Economical Alternative for Providing Drinking Water in Arid Regions,
W83-03179 3A

Parametric Study of Seawater Reverse Osmosis Desalting Plants,
W83-03316 3A

Organic Absorbents for Triple Point Absorption Freeze Crystallization Processes,
W83-03341 3A

A Center for the Transfer of Desalination Technology,
W83-03352 3A

Barrier Effect of Various Methods for Desalinating Seawater in the Presence of Chemical Pollutants (Obezzarazhivayushchii Effekt Razlichnykh Metodov Opresneniya Morskoi Vody V Usloviyakh ee Khimicheskogo Zagryazneniya),
W83-03404 3A

Fabrication of a 6,000 GPD Indirect Freezing Pilot Plant: Vol. 1,
W83-03462 3A

The Start-up and Testing of a 6,000 GPD Indirect Freeze Desalination Pilot Plant,
W83-03468 3A

DESALINATION PLANTS
Parametric Study of Seawater Reverse Osmosis Desalting Plants,
W83-03316 3A

Fabrication of a 6,000 GPD Indirect Freezing Pilot Plant: Vol. 1,
W83-03462 3A

The Start-up and Testing of a 6,000 GPD Indirect Freeze Desalination Pilot Plant,
W83-03468 3A

DESIGN CRITERIA
A Method for Calculating the Dimensions of Long Sewage Force Mains,
W83-03199 5D

Current Stormwater Drainage Practice in South Africa,
W83-03387 4A

New Design Guidelines for Vertical-Current Final Settling Tanks for Activated Sludge Plants (Neue Bemessungs-Grundlagen Fur Vertikal Durchstromite Nachklarkecken Von Belebungsanlagen),
W83-03437 5D

Inlet Construction for Vortex Drops With Supercritical Inflow (Einlaufkonstruktion Fur Wirbelfallschachte Mit Schiessendem Zufluss),
W83-03481 8B

DESIGN STORMS
Obtaining Rainfall Intensity Curves from Munich Rainfall Records (Die Ermittlung Von Regenspendelinien Aus Munchner Regenschreiberaufzeichnungen),
W83-03452 2B

Model Rainfall for Sewer System Design Current Knowledge and Recommendations (Modellregren Zur Kanalnetzbemessung - Kenntnisstand Und Empfehlungen),
W83-03453 2A

DESTRATIFICATION
Chesapeake Bay Nutrient and Plankton Dynamics. 1. Bacterial Biomass and Production During Spring Tidal Destratification in the York River, Virginia, Estuary,
W83-03264 2L

Computer Simulation of Local Destratification in Reservoirs,
W83-03279 5G

Artificial Destratification to Prevent Winterkill,
W83-03299 5G

DETENTION RESERVOIRS
Fate of Nitrogen and Phosphorus in a Waste-Water Retention Reservoir Containing Aquatic Macrophytes,
W83-03154 5D

DETRITUS
Effects of Sewage Pollution in the White River, Arkansas on Benthos and Leaf Detritus Decomposition,
W83-03332 5C

Large Organic Debris and Anadromous Fish Habitat in the Coastal Redwood Environment: The Hydrologic System,
W83-03335 2E

DEUTERIUM
Deuterium as a Tracer in the Groundwater Study of a Central North Dakota Mining Area,
W83-03177 5A

DEWATERING
Investigative Programs for Designing and Modeling Mine Water Control Systems,
W83-03265 4B

The Role of Cationic Surfactants in the Renovation of Water,
W83-03275 5F

Effect of Precipitation Purification on the Behavior of Sludges During Mechanical Dewatering (Einfluss Der Fallungsreinigung Auf Das Verhalten Von Klarschlammen Bei Der Mechanischen Entwasserung),
W83-03444 5D

DIATOMS
Post-Mining Neutralization of Acidic Surface Mine Lakes,
W83-03278 5B

DIELDRIN
Distributed Source Model for Pesticides in the Iowa River,
W83-03186 5B

DIGESTION
Use of Anaerobic Digestion in the Agricultural and Food Industries (Application De La Degestion Anaerobie Dans Les Industries Agro-Alimentaires),
W83-03252 5D

DINITROBENZENE
Biodegradation of 1,3-Dinitrobenzene,
W83-03155 5B

DISCHARGE MEASUREMENT
Verification of Step-Backwater Computations on Ephemeral Streams in Northeastern Wyoming,
W83-03366 2E

DISCHARGE MEASUREMENTS
Hydraulic Criteria for the Design of Weir Sills (Hydraulische Entwurfs- Und Bemessungskriterien fur Sohlschwellen),
W83-03241 8B

DISINFECTION
A Novel Bactericidal Agent for Treatment of Water,
W83-03337 5F

UV-Ozone Process for the Concurrent Decomposition of Halogenated Alkanes and the Disinfection of Water,
W83-03338 5F

DISSOLVED INORGANIC CARBON
Methodologies for Extraction of Dissolved Inorganic Carbon for Stable Carbon Isotope Studies: Evaluation and Alternatives,
W83-03359 2K

DISSOLVED OXYGEN
Effect of Aquatic Macrophytes on Physico-Chemical Parameters of Agricultural Drainage Water,
W83-03153 5G

DISTILLATION
Barrier Effect of Various Methods for Desalinating Seawater in the Presence of Chemical Pollutants (Obezzarazhivayushchii Effekt Razlichnykh Metodov Opresneniya Morskoi Vody V Usloviyakh ee Khimicheskogo Zagryazneniya),
W83-03404 3A

DITCHES
Sampling Macrofauna in Ditches,
W83-03217 7B

DIURNAL DISTRIBUTION
Diel Changes in Numbers and Activities of Bacterioplankton in a Reservoir in Relation to Algal Production,
W83-03263 2H

DOMINANT ORGANISMS
Control of Algal Dominance Through Changes in Zooplankton Grazing, Lake Washington: Phase I,
W83-03467 5G

DRAINAGE
The Phytoplankton Ecology of Devils Lake,
W83-03180 2H

Tufa Precipitation and its Effect on Drainage of Interstate Highways in Northeastern Ohio,
W83-03213 5B

Field Evaluation of a Water Management Simulation Model,
W83-03238 4A

Efficient Use of Water for Irrigation in the Upper Midwest,
W83-03282 6D

Basin-Scale Evapotranspiration Determination through Watershed and Climate Analyses,
W83-03328 2D

Current Stormwater Drainage Practice in South Africa,
W83-03387 4A

DREDGING
Assessing Enviromental Impacts of Open Water Disposal of Dredged Sediment,
W83-03251 6G

DRINKING WATER
Prechlorination and Trihalomethane Formation at Water Treatment,
W83-03228 5F

The Zurich Water Supply System,
W83-03229 5F

Inverse-Voltammetry of Some Copper Chelates Using a Carbon Paste Electrode. Determination of Copper in Drinking Water by Oxidation of Copper Dithio-Oxamide (Zur Invers-Voltammetrie Einiger Kupferchelate an Der Kohlepaste-Electrode. Bestimmung Von Kupfer in Trinkwasser Durch Oxidation Von Kupferdithiooxamid),
W83-03415 5A

Monitoring Flocculation in Water Treatment Using a Computer-Controlled Physical Model (Uberwachung der Wasseraufbereitung Mit Hilfe Eines Rechnergesteuerten Physikalischen Modells),
W83-03439 5F

Development and Status of Emergency Drinking Water Supply in the Federal Republic of Germany After Passage of the Water Safeguarding Law (Entwicklung und Stand Der Trinkwasser-Notversorgung in Der Bundesrepublik Nach Dem Wassersicherstellungsgesetz),
W83-03458 5F

Drinking Water Contamination with Chloro-Organic Compounds: Sources, Health Effects, Control (Contaminazione Delle Acque Potabili Da Composti Cloro-Organici: Origine, Effetti Biologici, Misure Di Protezione E Di Controllo),
W83-03476 5F

Macro and Trace-Elements in Drinking Water and Foods. Part 2 (Macro Ed Oligoelementi Nell'Apporto Idrico Ed Alimentare. Nota 2),
W83-03483 5B

DROUGHT
Comparative Study of the Causes and Effects of Recent Southeastern Droughts,
W83-03297 2B

DUAL PURPOSE DETENTION BASINS
Flood Control Effectiveness of Systems of Dual Purpose Detention Basins,
W83-03350 4A

DURATION CURVES
Hydrologic Flow Determination for Hydropower Feasibility Analysis,
W83-03271 2E

ECONOMETRIC MODELS
Toward an Econometric Model to Analyze Impacts of Water Availability on the Oregon Economy,
W83-03326 6A

ECONOMETRICS
Toward an Econometric Model to Analyze Impacts of Water Availability on the Oregon Economy,
W83-03326 6A

ECONOMIC ASPECTS
Wastewater Treatment in Rural Areas. There Doesn't Always Have to be a Central Wastewater Treatment Facility (Abwasserreinigung Im Lanlichen Raum. Es Muss Nicht Immer Eine Zentralklaranlage Sein).
W83-03435 5D

ECONOMIC FEASIBILITY
The Costs and Benefits of Soil Erosion Control in the North Lake Chicot Watershed,
W83-03331 4D

Expansion Potential for Irrigation Within the Mississippi Delta Region,
W83-03345 6B

ECONOMIC IMPACT
Economic Impacts of Transferring Water From Agriculture to Alternative Uses in Colorado,
W83-03303 6D

ECONOMIC MODELS
Efficient Use of Water for Irrigation in the Upper Midwest,
W83-03282 6D

ECONOMIC RENT
Use of Hedonic Price Technique to Evaluate Wetlands,
W83-03343 6B

ECONOMIC VALUE
Irrigation Water Response Function Estimation: An Improved Ridge Regression Methodology,
W83-03302 6D

ECOSYSTEMS LITTER
An Experimental Investigation of the Effects of Crude Oil on Two Freshwater Lake Ecosystems,
W83-03273 5C

EGERIA DENSA
Investigation Into Effective Control Methods for Brazilian Elodea (Egeria Densa Planchon) in Lake Marion, S.C.,
W83-03433 4A

EGYPT
Contribution to the Measurement of Evaporation in Remote Stations (Beitrag Zur Verdunstungsmessung in Abgelegenen Stationen),
W83-03225 7B

Analysis of Basin Irrigation Performance with Variable Inflow Rate,
W83-03410 3F

ELECTROCHEMICAL FLOW CELL
Determination of the Complexing Capacity of Water Systems by Gel Chromatographic and Electrochemical Techniques,
W83-03185 5A

ELECTROCHEMISTRY
Polarographic Determination of Low Levels of Cyanide and Metals in the Waste-Waters Discharged by an Electroplating Plant (Dosages Polarographiques de Faibles Quantities D'Ions Cyanure et de Metaux Dans Les Euax Rejetees Par un Atelier de Galvanoplastie),
W83-03412 5A

Application of Kelgraph to Electrochemical Detectors for Flow Injection Analysis and High Performance Liquid Chromatography,
W83-03490 5A

ELECTRODES
Characterization of Kel-F-Graphite Composite (Kelgraf) Electrodes and Application to Detection in Flowing Streams,
W83-03369 7B

ELECTRONIC EQUIPMENT
Opportunities and Potential Benefits of Radar Rainfall Measurements for the Federal Republic of Germany (Moglichkeiten und Potentieller Nutzen Eines Bundesdeutschen Niederschlagsradar--Verbundsystems),
W83-03240 7B

ELODEA
Effect of Aquatic Macrophytes on Physico-Chemical Parameters of Agricultural Drainage Water,
W83-03153 5G

ENERGY
Material and Energy Balance of Organic Matter in the Waters of the Rybinsk Reservoir and Lake Baikal,
W83-03478 2H

Water-Its Role From Now to the Year 2000,
W83-03491 6D

ENERGY CONSERVATION
Water and Energy Conservation Using Center Pivot Irrigation and Reduced Tillage Systems,
W83-03342 3F

ENERGY SOURCES
Energy Reclamation from the Drinking Water System with Series-Connected Pumps (Energieruckgewinnung Aus Dem Trinkwassersystem Mit Serienpumpen),
W83-03460 8C

ENGLAND
A Seasonal Study of the Distributions of Surface State Variables in Liverpool Bay. III. An Offshore Front,
W83-03173 2L

ENTEROBACTERIA
Barrier Effect of Various Methods for Desalinating Seawater in the Presence of Chemical Pollutants (Obezzarazhivayushchii Effekt Razlichnykh Metodov Opresneniya Morskoi Vody V Usloviyakh ee Khimicheskogo Zagryazneniya),
W83-03404 3A

ENVIORNMENTAL EFFECTS
Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

ENVIRONMENT
Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

ENVIRONMENTAL EFFECTS
A 'Before and After' Study of the Effects of Land Drainage Works on Fish Stocks in the Upper Reaches of a Lowland River,
W83-03192 6G

Large Organic Debris and Anadromous Fish Habitat in the Coastal Redwood Environment: The Hydrologic System,
W83-03335 2E

Environmental Problems of Reservoir Development with Special Regard to Conditions in Sweden,
W83-03393 6G

Aquatic Ecology Monitoring Network of the James Bay Power Co. (Le Reseau De Surveillance D'Ecologie Aquatique De La Societe D'Energie De La Baie James),
W83-03394 6G

An Evaluation of Proposed Cage Fish Culture on Loch Lomond, An Important Reservoir in Central Scotland,
W83-03403 6G

The Development and Effect of Fish Attractors on the Tennessee-Tombigbee Waterway,
W83-03419 6G

Development of a Reservoir Preparation Strategy,
W83-03420 6G

Comparison of Reservoirs with Dissimilar Selective Withdrawal Capabilities: Effects on Reservoir Limnology and Release Water Quality,
W83-03422 5G

Hydrobiology of the Littoral Zone of the Dnieper Estuary Under Conditions of Regulated Flow of the River,
W83-03480 6G

EPHEMERAL STREAMS
Field Rating Evaluation of a Large Supercritical Measurement Flume,
W83-03239 7B

Verification of Step-Backwater Computations on Ephemeral Streams in Northeastern Wyoming,
W83-03366 2E

EQUIPMENT
How Pulsators and Superpulsators Can Improve the Water Treatment Process,
W83-03220 5F

EQUITABLE APPORTIONMENT APPROPRIATION
The Escatawpa River - An Interstate Approach to Water Resource Management,
W83-03354 6E

EROSION
Effect of Incorporation of Fall-Applied Fertilizer on Runoff Losses of Nutrients and Soil From Soybean Ground,
W83-03298 2J

EROSION CONTROL
Horses in Suburbia,
W83-03176 5G

Conservation of Soil, Water, andd Energy Through Reduced Tillage Systems - Phase I sub 1,
W83-03287 4D

ESCATAWPA RIVER
The Escatawpa River - An Interstate Approach to Water Resource Management,
W83-03354 6E

ESCHERICHIA COLI
Chemostat Adaptation of Escherichia Coli B/r/1 to Low Water Activity,
W83-03151 5D

ESTERASE
Changes in Esterase Zymograms of a Planktonic Copepod, Acartia Clausi, in a Polluted Marine Area (Sewage Output of Marseilles) (Modifications Des Zymogrammes Des Esterases D'Un Copepode Planctonique, Acartia Clausi Dans Une Emissaire De Marseille),
W83-03386 5C

ESTUARIES
Production of Invertebrates in the Tidewater Zone of a Coastal River and Adjacent Estuary,
W83-03183 2L

Composition of Estuarine Colloidal Material: Organic Components,
W83-03202 2L

Sedimentologic Study of the Mouth of the Gabon River Estuary (Etude Sedimentologique De L'Embouchure De L'Estuaire Du Gabon),
W83-03257 2L

Particulate Matter Resuspension Via Metabolically Produced Gas Bubbles From Benthic Estuarine Microalgae Communities,
W83-03261 2L

Chesapeake Bay Nutrient and Plankton Dynamics. 1. Bacterial Biomass and Production During Spring Tidal Destratification in the York River, Virginia, Estuary,
W83-03264 2L

ESTUARINE ENVIRONMENT
Production of Invertebrates in the Tidewater Zone of a Coastal River and Adjacent Estuary,
W83-03183 2L

EUTROPHIC LAKES
The Influence of Sample Treatment on Nutrient Analysis in Eutrophic Waters (Der Einfluss Der Probenbehandlung Auf Die Nahrstoffanalytik Bei Eutrophen Gewassern),
W83-03392 5A

EUTROPHICATION
A Study of Eutrophication and Aquatic Plants Growths in Selected Lakes and Rivers of Puerto Rico,
W83-03300 5C

The Biological Regulation of Bloom-Causing Blue-Green Algae: A Feasible Alternative,
W83-03311 5C

Nutrient Contents and Algal Growth in an Impounded River: Effects on Oxygen Balance and need for Nutrient Retention (Nahrstoffgehalte und Algenwachstum in Einem Gestauten Fluss, Auswirkungen Auf Die Sauerstoffbilanz Und Notwendigkeit Des Nahrstoffruckhaltes),
W83-03454 5C

Tendencies in the Changes in the Saprobic Conditions of the Maritsa River (Tendentsii V Izmenenyata Na Saprobiolodgichnoto Sustoyanie Na Reka Maritsa),
W83-03473 5C

The Species Deficit of the Macrozoobenthic Communities as a Criterion for the Transsaprobic Influences on the Maritsa River (Vidoviyat Defitsit Na Makrozoobentosnite Suobshchestva Kato Kriterii Za Transsaprobnite Vliyaniya Vurkhu Reka Maritsa),
W83-03475 5C

EVAPORATION
Barge-Mounted Plant for Desalination: An Economical Alternative for Providing Drinking Water in Arid Regions,
W83-03179 3A

Basin-Scale Evapotranspiration Determination through Watershed and Climate Analyses,
W83-03328 2D

EVAPORIMETERS
Contribution to the Measurement of Evaporation in Remote Stations (Beitrag Zur Verdunstungsmessung in Abgelegenen Stationen),
W83-03225 7B

EVAPOTRANSPIRATION
Measurement of Actual Transpiration of Native Grass Stands as a Component of Nebraska Sandhills Groundwater Hydrology,
W83-03312 2D

Field Study of Actual Evapotranspiration of a Wheat Crop (Etude 'In Situ' De L'Evapotranspiration Reelle D'une Culture De Ble),
W83-03389 2D

FABRICATION
Fabrication of a 6,000 GPD Indirect Freezing Pilot Plant: Vol. 1,
W83-03462 3A

FARMING
Soil Conservation and Water Quality Improvement: What Farmers Think,
W83-03161 4D

Technology Assessment of Irrigation Scheduling and Crop Response,
W83-03488 3F

FATE OF POLLUTANTS
Applications of a Serratia Marcescens Bacteriophage as a New Microbial Tracer of Aqueous Environments,
W83-03165 5B

Aquatic Plant Control and Disappearance of Terbutryn from Treated Waters in Ontario, Canada, 1974-1977,
W83-03166 4A

Modification of Pollutant Hydrolysis Kinetics in the Presence of Humic Substances,
W83-03193 5B

Free Ionic Nickel Accumulation and Localization in the Freshwater Zooplankter, Daphnia Magna,
W83-03256 5B

FEASIBILITY STUDIES
Hydrologic Flow Determination for Hydropower Feasibility Analysis,
W83-03271 2E

FECES
Viral Contamination of Seawater at Messina (Inquinamento Di Natura Virale Delle Acque Di Mare Della Citta'Di Messina),
W83-03484 5B

Relationships Among the Bacteria Indicators of Fecal Pollution in the Water of the River Brenta (Relazioni Tra Gli Indicatori Di Inquinamento Fecale Nelle Acque Del Fiume Brenta)
W83-03485 5A

FEDERAL REPUBLIC OF GERMANY
Mathematical Model for Long-Term Water Supply Planning (Mathematisches Modell Fur Die Langfristige Wasserversorgungsplanung),
W83-03224 6A

Opportunities and Potential Benefits of Radar Rainfall Measurements for the Federal Republic of Germany (Moglichkeiten und Potentieller Nutzen Eines Bundesdeutschen Niederschlagsradar--Verbundsystems),
W83-03240 7B

Costs of Phosphate Elimination in Municipal Wastewater Facilities (Kosten Der Phosphatelimination in Kommunalen Klaranlagen),
W83-03436 5D

Monitoring Flocculation in Water Treatment Using a Computer-Controlled Physical Model (Uberwachung der Wasseraufbereitung Mit Hilfe Eines Rechnergesteuerten Physikalischen Modells),
W83-03439 5F

The Meaning of the Generally Accepted Technological Standards for the Planning, Construction, and Operation of Water Distribution Facilities (Die Bedeutung Der Anerkannten Regeln Der Technik Fur Planung, Bau und Betrieb Von Wasserversorgungsanlagen),
W83-03441 6E

Obtaining Rainfall Intensity Curves from Munich Rainfall Records (Die Ermittlung Von Regenspendelinien Aus Munchner Regenschreiberaufzeichnungen),
W83-03452 2B

Model Rainfall for Sewer System Design Current Knowledge and Recommendations (Modellregren Zur Kanalnetzbemessung - Kenntnisstand Und Empfehlungen),
W83-03453 2A

FEDERAL REPUBLIC OF WEST GERMANY
Groundwater Purification by Infiltration of Ozonized Water (Grundwassersanierung Durch Infiltration Von Ozontem Wasser),
W83-03200 5G

FEEDING RATES
Control of Algal Dominance Through Changes in Zooplankton Grazing, Lake Washington: Phase I,
W83-03467 5G

FERTILIZATION
Effect of Incorporation of Fall-Applied Fertilizer on Runoff Losses of Nutrients and Soil From Soybean Ground,
W83-03298 2J

FIELD TESTS
Contribution to the Measurement of Evaporation in Remote Stations (Beitrag Zur Verdunstungsmessung in Abgelegenen Stationen),
W83-03225 7B

Final Results of Testing of Abcor 8 Inches Spiral Wound Ultra-Filters at The Wrightsville Beach Test Facility,
W83-03288 3A

FILTERS
Final Results of Testing of Abcor 8 Inches Spiral Wound Ultra-Filters at The Wrightsville Beach Test Facility,
W83-03288 3A

New Design Guidelines for Vertical-Current Final Settling Tanks for Activated Sludge Plants (Neue Bemessungs-Grundlagen Fur Vertikal Durchstromite Nachklarkecken Von Belebungsanlagen),
W83-03437 5D

FILTRATION
Reuse of Treated Municipal Wastewater in the Technical Supply of Industrial Companies in Moscow (Die Wiederverwendung Des Gereinigten Kommunalen Abwasser In Der Technischen Wasserversorgung Der Moskauer Industriebetriebe),
W83-03222 5D

Mother Nature as Sludge Thickener,
W83-03227 5F

Use of Polyethylene Imines in Flotation and Improving the Filtration of Suspensions of Blue-Green Algae,
W83-03471 5F

FINITE ELEMENT ANALYSIS
Hydraulic Analysis of Surcharged Storm Sewer Systems,
W83-03374 8B

FISH
The Biota of Oklahoma Springs: Natural Biological Monitoring of Groundwater Quality,
W83-03347 2H

Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

FISH ATTRACTORS
The Development and Effect of Fish Attractors on the Tennessee-Tombigbee Waterway,
W83-03419 6G

FISH DIETS
Biological Role of Perch in the Kremenchug Reservoir,
W83-03472 2H

FISH FARMING
Fish Farm Effluents--Cause for Concern,
W83-03237 5B

FISH POPULATIONS
A 'Before and After' Study of the Effects of Land Drainage Works on Fish Stocks in the Upper Reaches of a Lowland River,
W83-03192 6G

FISH PRODUCTION FORECASTING
Aquaculture Techniques: A Production Forecasting Model for Aquaculture Systems,
W83-03318 8I

FISHERIES
Efficient Utilization of Industrial Waster and Waste Heat for Intensive Fish Production (Die Rationelle Nutzung Von Industriewasser Und Abwarme Fur Eine Intensive Fischproduktion),
W83-03221 3C

An Evaluation of Proposed Cage Fish Culture on Loch Lomond, An Important Reservoir in Central Scotland,
W83-03403 6G

FIXED COSTS
Cost and Precision in a Stream Sampling Program,
W83-03336 6C

FLASH FLOODS
Johnstown-Western Pennsylvania Storm and Floods of July 19-20, 1977,
W83-03357 2E

FLOCCULATION
New Design Guidelines for Vertical-Current Final Settling Tanks for Activated Sludge Plants (Neue Bemessungs-Grundlagen Fur Vertikal Durchstromite Nachklarkecken Von Belebungsanlagen),
W83-03437 5D

Monitoring Flocculation in Water Treatment Using a Computer-Controlled Physical Model (Uberwachung der Wasseraufbereitung Mit Hilfe Eines Rechnergesteuerten Physikalischen Modells),
W83-03439 5F

FLOOD CONTROL
Modelling the Flood Alleviation Scheme for the Usk at Brecon,
W83-03247 8B

Flood Loss Reduction Through Interstate Compacts: An Under-Utilized Approach,
W83-03324 6F

The Flood Mitigation Potential of Inland Wetlands,
W83-03349 6A

Flood Control Effectiveness of Systems of Dual Purpose Detention Basins,
W83-03350 4A

Current Stormwater Drainage Practice in South Africa,
W83-03387 4A

FLOOD DAMAGE
An Economic Analysis of the Devils Lake Basin and Proposed Land Use,
W83-03270 6B

Urban Flood Damage Estimating Curves,
W83-03294 2E

FLOOD PEAK
Johnstown-Western Pennsylvania Storm and Floods of July 19-20, 1977,
W83-03357 2E

FLOOD PLAIN MANAGEMENT
Urban Flood Damage Estimating Curves,
W83-03294 2E

FLOOD PLAINS
The Effects of Altered Hydrologic Regime on Tree Growth Along the Missouri River in North Dakota,
W83-03262 6G

FLOODING
An Economic Analysis of the Devils Lake Basin and Proposed Land Use,
W83-03270 6B

FLOODS
Winter of Frosts, Floods and Bursts.
W83-03244 5F

FLORIDA
Particulate Matter Resuspension Via Metabolically Produced Gas Bubbles From Benthic Estuarine Microalgae Communities,
W83-03261 2L

Production and Decomposition of Forest Litter Fall on the Apalachicola River Flood Plain, Florida,
W83-03364 5B

FLOW
Fluid Mechanics - The Green Function of the Neumann-Kelvin Problem in a Canal,
W83-03188 8B

FLOW CHARACTERISTICS
Applications of a Serratia Marcescens Bacteriophage as a New Microbial Tracer of Aqueous Environments,
W83-03165 5B

The Construction and Operation of an Articulated Laboratory Flow Channel,
W83-03230 8B

FLOW MEASUREMENT
Field Rating Evaluation of a Large Supercritical Measurement Flume,
W83-03239 7B

FLOW PROFILES
The Construction and Operation of an Articulated Laboratory Flow Channel,
W83-03230 8B

FLOW RATE
Analysis of Basin Irrigation Performance with Variable Inflow Rate,
W83-03410 3F

FLUID FLOW
Fluid Mechanics - The Green Function of the Neumann-Kelvin Problem in a Canal,
W83-03188 8B

FLUMES
Field Rating Evaluation of a Large Supercritical Measurement Flume,
W83-03239 7B

FLUORESCENCE QUENCHING
Copper(II) Complexing Capacities of Natural Waters by Fluorescence Quenching,
W83-03396 5A

FLUOROMETRY
Fluorimetric Determination of Chloroform in Drinking Water,
W83-03190 5A

Determination of PAH in Water and Sediments by Low Temperature Fluorimetry (Dosage Des Hydrocarbures Aromatiques Polynucleaires Dan Les Eaux Et Les Sediments Par Fluorimetrie A Basse Temperature),
W83-03413 5A

FLUSHING
Flushing of Reservoirs as a Means of Increasing the Operating Efficiency of Hydroelectric Stations,
W83-03198 8A

FOOD CHAINS
Industrial Effluents as a Source of Mercury Contamination in Terrestrial Riparian Vertebrates,
W83-03402 5B

FOOD PROCESSING INDUSTRY
Use of Anaerobic Digestion in the Agricultural and Food Industries (Application De La Degestion Anaerobie Dans Les Industries Agro-Alimentaires),
W83-03252 5D

FOODS
Macro and Trace-Elements in Drinking Water and Foods. Part 2 (Macro Ed Oligoelementi Nell'Apporto Idrico Ed Alimentare. Nota 2),
W83-03483 5B

FORECASTING
Real-Time Forecasting of River Flows and Stochastic Optimal Control of Multireservoir Systems,
W83-03323 4A

Factors Influencing Hourly and Daily Water Demand (Uber Die Stunden-Und Tagewasserbedarf Beeinflussenden Faktoren),
W83-03438 6D

Water Availability in the New Mexico Upper Rio Grande Basin to the Year 2000,
W83-03493 6D

FOREST MANAGEMENT
Effects of Silvicultural Practices on Water Quality in Northern Wisconsin,
W83-03304 5G

FOREST PRACTICES
Assessment of Stormflow and Water Quality From Undisturbed and Site Prepared Forest Land in East Texas,
W83-03277 4C

FOREST WATERSHEDS
Assessment of Stormflow and Water Quality From Undisturbed and Site Prepared Forest Land in East Texas,
W83-03277 4C

Effects of Silvicultural Practices on Water Quality in Northern Wisconsin,
W83-03304 5G

FRACTURE PERMEABILITY
Ground Water Quantity and Quality in Fracture Zones in Abbeville County, South Carolina,
W83-03466 3B

FRANCE
Study of the Changes in River Water Quality (Etude De L'Evolution De La Qualite Des Eaux De Riviere),
W83-03267 5B

Changes in Esterase Zymograms of a Planktonic Copepod, Acartia Clausi, in a Polluted Marine Area (Sewage Output of Marseilles) (Modifications Des Zymogrammes Des Esterases D'Un Copepode Planctonique, Acartia Clausi Dans Une Emissaire De Marseille),
W83-03386 5C

Polarographic Determination of Low Levels of Cyanide and Metals in the Waste-Waters Discharged by an Electroplating Plant (Dosages Polarographiques de Faibles Quantities D'Ions Cyanure et de Metaux Dans Les Euax Rejetees Par un Atelier de Galvanoplastie),
W83-03412 5A

Determination of PAH in Water and Sediments by Low Temperature Fluorimetry (Dosage Des Hydrocarbures Aromatiques Polynucleaires Dan Les Eaux Et Les Sediments Par Fluorimetrie A Basse Temperature),
W83-03413 5A

Trace Toxic Metals Determination in Natural Waters Using X-Ray Fluorescence Spectrometry on a Chelating Resin Captor (Determination De Traces Metaux Toxiques Dans Les Eaux Naturelles Par Spectrometrie De Fluorescence X Sur Capteur De Resine Chelatante),
W83-03414 5A

FREEZE-THAW TESTS
Mother Nature as Sludge Thickener,
W83-03227 5F

FREEZING
Vitrification of Pure Liquid Water by High Pressure Jet Freezing,
W83-03259 1A

Organic Absorbents for Triple Point Absorption Freeze Crystallization Processes,
W83-03341 3A

Fabrication of a 6,000 GPD Indirect Freezing Pilot Plant: Vol. 1,
W83-03462 3A

FROST
Winter of Frosts, Floods and Bursts.
W83-03244 5F

FULVIC ACIDS
The Role of Fulvic Substances on Trace Metal Partitioning in Natural Aquatic Sediments,
W83-03348 2K

FURROW IRRIGATION
Irrigation Water Conservation by Using Wide-Spaced Furrows,
W83-03408 3F

GABON
Sedimentologic Study of the Mouth of the Gabon River Estuary (Etude Sedimentologique De L'Embouchure De L'Estuaire Du Gabon),
W83-03257 2L

GAGES
Hydraulic Criteria for the Design of Weir Sills (Hydraulische Entwurfs- Und Bemessungskriterien fur Sohlschwellen),
W83-03241 8B

GAS BUBBLES
Particulate Matter Resuspension Via Metabolically Produced Gas Bubbles From Benthic Estuarine Microalgae Communities,
W83-03261 2L

GAS CHROMATOGRAPHY
Identification and Quantification of Water Soluble Components of Outboard Motor Exhaust and of Gasoline in a North Dakota Lake,
W83-03428 5A

GAS EVOLUTION TECHNIQUES
Methodologies for Extraction of Dissolved Inorganic Carbon for Stable Carbon Isotope Studies: Evaluation and Alternatives,
W83-03359 2K

GEOCHEMISTRY
Radioelements, Radiogenic Helium and Age Relationships for Groundwaters From the Granites at Stripa, Sweden,
W83-03208 2F

Extreme Fractionation of U234/U238 and TH230/U234 in Spring Waters, Sediments, and Fossils at the Pomme De Terre Valley, Southwestern Missouri,
W83-03209 2K

GEOHYDROLOGY
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-5A, H-5B, and H-5C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03360 2K

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-6A, H-6B, and H-6C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03361 2K

Reliability and Verification of Geohydrologic Models (Zuverlassigkeit Und Verifikation Von Geohydrologischen Modellen),
W83-03448 2F

GEOMORPHOLOGY
Evaluation and Monitoring of the Hydrologic Impact of Cabin Creek, B.C. Coal Pit Mining on the North Fork of the Flathead River,
W83-03325 6G

GEORGIA
Production of Invertebrates in the Tidewater Zone of a Coastal River and Adjacent Estuary,
W83-03183 2L

Quantitative Models and Analysis of Urban Nonpoint Source Water Pollution Control Systems,
W83-03184 6A

Urban Flood Damage Estimating Curves,
W83-03294 2E

Basin-Scale Evapotranspiration Determination through Watershed and Climate Analyses,
W83-03328 2D

GEOTHERMAL RESOURCES
Trans-Boundary Geothermal Resources of Texas and Mexico,
W83-03499 2F

GEOTHERMAL STUDIES
'Geothermal Mineral Equilibria.' Reply to a Comment by M. A. Grant,
W83-03416 2K

On the Lack of a Unique Relation Between C02 Partial Pressure and Temperature in Geothermal System. Comment on 'Geothermal Mineral Equilibria' by W. F. Giggenbach,
W83-03434 2K

GERMAN DEMOCRATIC REPUBLIC
Problems of the Load at Veb Zellstoff-Und Papierfabrik Rosenthal (Probleme Der Abwasserlast Im Veb Zellstoff-Und Papierfabrik Rosenthal),
W83-03223 5D

The Influence of Sample Treatment on Nutrient Analysis in Eutrophic Waters (Der Einfluss Der Probenbehandlung Auf Die Nahrstoffanalytik Bei Eutrophen Gewassern),
W83-03392 5A

GLACIERS
Calving Speed of Alaska Tidewater Glaciers, With Application to Columbia Glacier,
W83-03358 2C

GOVERNMENTAL INTERRELATIONS
Development and Status of Emergency Drinking Water Supply in the Federal Republic of Germany After Passage of the Water Safeguarding Law (Entwicklung und Stand Der Tinkwasser-Notversorgung in Der Bundesrepublik Nach Dem Wassersicherstellungsgesetz),
W83-03458 5F

GRAIN SORGHUM
Efficiency of Water Use by Crops Under Allelopathy Stress,
W83-03313 2I

GRANITES
Radioelements, Radiogenic Helium and Age Relationships for Groundwaters From the Granites at Stripa, Sweden,
W83-03208 2F

GRAPHICAL ANALYSIS
Study of the Changes in River Water Quality (Etude De L'Evolution De La Qualite Des Eaux De Riviere),
W83-03267 5B

GRAPHICAL METHODS
Modified Monthly Minimum Method for Rapid Calculation of Groundwater Recharge from Receiving Stream Runoff (Das Modifizierte Verfahren MoMNO (r12) Zur Raschen Ermittlung Der Grundwasserneubildungsrate Aus Dem Vorfluterabfluss),
W83-03447 2F

GROUNDWATER
Deuterium as a Tracer in the Groundwater Study of a Central North Dakota Mining Area,
W83-03177 5A

Groundwater Purification by Infiltration of Ozonized Water (Grundwassersanierung Durch Infiltration Von Ozontem Wasser),
W83-03200 5G

The Zurich Water Supply System,
W83-03229 5F

Hydrology of Area 14, Eastern Coal Province, Kentucky,
W83-03355 7C

Use of Water in Arkansas, 1980,
W83-03367 6D

Organic Matter Pollution of Groundwater Near Highways (Belastung Des Grundwassers Mit Organischen Stoffen Im Gebiet Von Strassen),
W83-03446 5B

GROUNDWATER BUDGET
The Groundwater Budget of Lake Wingra, Dane County, Wisconsin,
W83-03305 2F

GROUNDWATER DATING
Radioelements, Radiogenic Helium and Age Relationships for Groundwaters From the Granites at Stripa, Sweden,
W83-03208 2F

GROUNDWATER DEPLETION
Effects of Groundwater Pumpage on Surface and Groundwater Flows on Adjoining Basins,
W83-03431 4B

GROUNDWATER LEVEL
Monitoring of Groundwater Levels for Real-Time Conjunctive Water Management,
W83-03333 7B

GROUNDWATER MANAGEMENT
Groundwater Purification by Infiltration of Ozonized Water (Grundwassersanierung Durch Infiltration Von Ozontem Wasser),
W83-03200 5G

Investigative Programs for Designing and Modeling Mine Water Control Systems,
W83-03265 4B

Overview of Groundwater Law and Institutions in United States Border States,
W83-03496 6E

Texas Groundwater Law: A Survey and Some Proposals,
W83-03497 6E

California Groundwater Management: The Sacred and the Profane,
W83-03498 6E

GROUNDWATER MOVEMENT
The Groundwater Budget of Lake Wingra, Dane County, Wisconsin,
W83-03305 2F

GROUNDWATER POLLUTION
Organics Transported Through Selected Geologic Media: Assessment of Organics Transported Away From Industrial Waste Disposal Sites,
W83-03375 5A

Texas Groundwater Law: A Survey and Some Proposals,
W83-03497 6E

GROUNDWATER RECHARGE
Environmental Isotopic and Hydrogeochemical Investigation of Recharge and Subsurface Flow in Eagle Valley, Nevada,
W83-03380 2F

Effects of Groundwater Pumpage on Surface and Groundwater Flows on Adjoining Basins,
W83-03431 4B

Modified Monthly Minimum Method for Rapid Calculation of Groundwater Recharge from Receiving Stream Runoff (Das Modifizierte Verfahren MoMNO (r12) Zur Raschen Ermittlung Der Grundwasserneubildungsrate Aus Dem Vorfluterabfluss),
W83-03447 2F

Improved Formulas for Estimating Groundwater Supplies by Short-Term Precipitation-Minimum Series (Verbesserte Ansatza Fuer Die Schatzung Der Dargebote Von Grundwassermengen Durch Niederschlags-Minimum-Kurzreihen),
W83-03461 2A

GROUNDWATER-RESERVOIR INTERACTIONS
Use of Seepage Meters and Mini-Piezometers for Identification of Reservoir - Groundwater Interactions in Lake Mead, Nevada,
W83-03487 7B

GROUNDWATER RESOURCES
An Economic Analysis of Obstacles to Water Conservation in Montana Water Law,
W83-03464 4B

GROWTH KINETICS
The Effects of Altered Hydrologic Regime on Tree Growth Along the Missouri River in North Dakota,
W83-03262 6G

Diel Changes in Numbers and Activities of Bacterioplankton in a Reservoir in Relation to Algal Production,
W83-03263 2H

HARDNESS
Removal of Nitrate, Sulfate and Hardness from Groundwater by Ion Exchange,
W83-03290 5F

HAWAII
Rainfall Cell Size From Rit Curve Analysis,
W83-03339 2B

Water Quality of Airport Storm Runoff,
W83-03353 5B

HEAT TRANSFER
Experimental and Analytical Study of Heat Transfer and Mixing in Thermally Stratified Buoyant Flows,
W83-03370 2H

The Start-up and Testing of a 6,000 GPD Indirect Freeze Desalination Pilot Plant,
W83-03468 3A

HEATED WASTEWATER
The Use of Industrial Waste Water. I. Aerial and Soil Microclimatic Modifications Due to Heating by Wastewater (20 Degrees C) Circulating in Buried Pipes (Utilisation Des Eaus De Rejet En Agriculture, I. Modifications Microclimatiques Dues Au Chauffage Du Sol Par Tuyaux Enterres, En Plein Champ)
W83-03388 3C

HEAVY METALS
The Efficacy of Removal of Heavy Metals from Water by Calcite,
W83-03157 5F

Identification and Assessment of Effluent Residuals in Treated Leachate from Landfill Disposal Sites,
W83-03272 5E

An Evaluation of Sediments in the Middle Rio Grande, Elephant Butte Reservoir, and Caballo Reservoir as Potential Sources for Toxic Meterials,
W83-03322 5B

Effects of Coal Burning in New Mexico on Air Quality and Surface Water Quality: Raton Study Area,
W83-03382 2K

Trace Toxic Metals Determination in Natural Waters Using X-Ray Fluorescence Spectrometry on a Chelating Resin Captor (Determination De Traces Metaux Toxiques Dans Les Eaux Naturelles Par Spectrometrie De Fluorescence X Sur Capteur De Resine Chelatante),
W83-03414 5A

Heavy Metals in Flowing Waters and River Sediments of the Western Harz Region (Schwermetalle in Den Fliessgewassern Und Flusssedimenten Des West-Harzes,
W83-03457 5B

HEDONIC PRICE TECHNIQUE
Use of Hedonic Price Technique to Evaluate Wetlands,
W83-03343 6B

HEPATOPANCREAS
The Effect of Hormonal Pollutants on Aquatic Crustacea and the Surrounding Environment,
W83-03314 5C

HERBICIDES
Effect of Hydout and Aquathol K on Hydrilla in Gatun Lake, Panama,
W83-03162 4A

Threshold 2,4-D Concentrations for Control of Eurasian Watermilfoil and Sago Pondweed,
W83-03163 4A

Aquatic Plant Control and Disappearance of Terbutryn from Treated Waters in Ontario, Canada, 1974-1977,
W83-03166 4A

Effects of Simazine Treatment on Channel Catfish Production and Water Quality in Ponds,
W83-03167 5G

HIGH INTENSITY RAINFALL
Rainfall Cell Size From Rit Curve Analysis,
W83-03339 2B

HIGH PRESSURE
Comparative Study of the Causes and Effects of Recent Southeastern Droughts,
W83-03297 2B

HIGHWAYS
Tufa Precipitation and its Effect on Drainage of Interstate Highways in Northeastern Ohio,
W83-03213 5B

Organic Matter Pollution of Groundwater Near Highways (Belastung Des Grundwassers Mit Organischen Stoffen Im Gebiet Von Strassen),
W83-03446 5B

HISTORY
The Evolution of California State Water Planning 1850-1928,
W83-03274 6E

Berlin Water '81 -- 125 Years of Central Water Distribution (Wasser Berlin '81 -- 125 Jahre Zentrale Wasserversorgung),
W83-03455 5F

HOME SEWAGE DISPOSAL
On-Site Sewage Disposal: Site Suitability, System Selection and Soil Absorption Area Sizing,
W83-03268 5D

HONOLULU INTERNATIONAL AIRPORT
Water Quality of Airport Storm Runoff,
W83-03353 5B

HUMIC ACIDS
Modification of Pollutant Hydrolysis Kinetics in the Presence of Humic Substances,
W83-03193 5B

HUNTING
An Economic Analysis of the Devils Lake Basin and Proposed Land Use,
W83-03270 6B

HYDRAULIC ENGINEERING
Inlet Construction for Vortex Drops With Supercritical Inflow (Einlaufkonstruktion Fur Wirbelfallschachte Mit Schiessendem Zufluss),
W83-03481 8B

HYDRAULIC EQUIPMENT
Slide Valves Save Costs.
W83-03232 8C

Keeping the Flow Smooth.
W83-03249 8C

HYDRAULIC VALVES
Slide Valves Save Costs.
W83-03232 8C

HYDRAULICS
Fluid Mechanics - The Green Function of the Neumann-Kelvin Problem in a Canal,
W83-03188 8B

Hydraulic Analysis of Surcharged Storm Sewer Systems,
W83-03374 8B

HYDROCARBONS
Influence of Land Utilization on Hydrocarbon Runoff Pollution,
W83-03156 5B

Determination of PAH in Water and Sediments by Low Temperature Fluorimetry (Dosage Des Hydrocarbures Aromatiques Polynucleaires Dan Les Eaux Et Les Sediments Par Fluorimetrie A Basse Temperature),
W83-03413 5A

Identification and Quantification of Water Soluble Components of Outboard Motor Exhaust and of Gasoline in a North Dakota Lake,
W83-03428 5A

HYDROELECTRIC POWER
A Manual for Developing Small-Scale and Micro-Hydropower Plants in Idaho - A Guide to Permits, Licenses, and Incentives,
W83-03320 6E

An Assessment of the Use Potential of the Flow of Water at the Spring 'Ojo de Agua' in Aguadilla, Puerto Rico,
W83-03321 4B

Environmental Problems of Reservoir Development with Special Regard to Conditions in Sweden,
W83-03393 6G

HYDROELECTRIC PROJECT LICENSING
A Manual for Developing Small-Scale and Micro-Hydropower Plants in Idaho - A Guide to Permits, Licenses, and Incentives,
W83-03320 6E

HYDROGEN ION CONCENTRATION
Developments, Recommendations and Applications of Tests for Evaluating the Chemical Stability of High-Level Radioactive Solid Waste Forms,
W83-03427 5B

HYDROGEN ION CONCENTRATIONS
The Role of Fulvic Substances on Trace Metal Partitioning in Natural Aquatic Sediments,
W83-03348 2K

HYDROGEN SULFIDE
Hygienic Evaluation of Hydrogen Sulfide-Containing Thermal Waters Used in Hot Water Supply Systems (Gigiena Otsenka Serovodnykh Termal'Nykh Vod, Ispol'Zuemykh V Sisteme Goryachego Vodosnabzheniya),
W83-03405 5C

HYDROGEOLOGY
Geohydrology of the Rio Camuy Cave System, Puerto Rico,
W83-03283 2F

HYDROGRAPHS
Modified Monthly Minimum Method for Rapid Calculation of Groundwater Recharge from Receiving Stream Runoff (Das Modifizierte Verfahren MoMNO (r12) Zur Raschen Ermittlung Der Grundwasserneubildungsrate Aus Dem Vorfluterabfluss),
W83-03447 2F

HYDROLOGIC DATA
Opportunities and Potential Benefits of Radar Rainfall Measurements for the Federal Republic of Germany (Moglichkeiten und Potentieller Nutzen Eines Bundesdeutschen Niederschlagsradar--Verbundsystems),
W83-03240 7B

Hydrologic Flow Determination for Hydropower Feasibility Analysis,
W83-03271 2E

Hydrology of Area 14, Eastern Coal Province, Kentucky,
W83-03355 7C

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-5A, H-5B, and H-5C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03360 2K

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-6A, H-6B, and H-6C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03361 2K

HYDROLOGIC MODELS
Investigative Programs for Designing and Modeling Mine Water Control Systems,
W83-03265 4B

HYDROLYSIS
Modification of Pollutant Hydrolysis Kinetics in the Presence of Humic Substances,
W83-03193 5B

ICE
Vitrification of Pure Liquid Water by High Pressure Jet Freezing,
W83-03259 1A

ICE COVER
Backwater Curve Computations Under Ice Covers in the La Grande River (Courbes De Remous Sous Les Couverts De Glace De La Grande Riviere),
W83-03395 2C

ICE FORMATION
Backwater Curve Computations Under Ice Covers in the La Grande River (Courbes De Remous Sous Les Couverts De Glace De La Grande Riviere),
W83-03395 2C

ICEBERGS
Calving Speed of Alaska Tidewater Glaciers, With Application to Columbia Glacier,
W83-03358 2C

ICELAND
The Chemistry of Geothermal Waters in Iceland. I. Calculation of Aqueous Specification from 0 to 370C,
W83-03201 2K

IDAHO
Hydrologic Flow Determination for Hydropower Feasibility Analysis,
W83-03271 2E

Index Construction for Multiple Objective Analysis of Land and Water Use in a High Mountain Watershed,
W83-03286 6A

A Manual for Developing Small-Scale and Micro-Hydropower Plants in Idaho - A Guide to Permits, Licenses, and Incentives,
W83-03320 6E

Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho--Emphasis: 1974-1978,
W83-03365 5B

ILLINOIS
Undisturbed Core Method for Determining and Evaluating the Hydraulic Conductivity of Unsaturated Sediments,
W83-03319 2G

Identification of the Water Quality Factors Which Prevent Fingernail Clams From Recolonizing the Illinois River, Phase III,
W83-03463 5C

ILLINOIS RIVER
Identification of the Water Quality Factors Which Prevent Fingernail Clams From Recolonizing the Illinois River, Phase III,
W83-03463 5C

IMAGE PROCESSING
Landsat Monitoring of Irrigated Farmland Acreage in Curry County, New Mexico,
W83-03310 7A

INDEXING
Index Construction for Multiple Objective Analysis of Land and Water Use in a High Mountain Watershed,
W83-03286 6A

INDICATORS
Studies of Activation Products in the Terrestrial Environments of Three Swedish Nuclear Power Stations,
W83-03397 5B

INDIRECT FREEZING PROCESS
The Start-up and Testing of a 6,000 GPD Indirect Freeze Desalination Pilot Plant,
W83-03468 3A

INDUSTRIAL WASTES
Physiochemical Pretreatment of Landfill Leachates Using Coagulation,
W83-03172 5G

Problems of the Load at Veb Zellstoff-Und Papierfabrik Rosenthal (Probleme Der Abwasserlast Im Veb Zellstoff-Und Papierfabrik Rosenthal),
W83-03223 5D

Wet Oxidation for the Treatment of Toxic Industrial Wastes.
W83-03235 5D

Use of Anaerobic Digestion in the Agricultural and Food Industries (Application De La Degestion Anaerobie Dans Les Industries Agro-Alimentaires),
W83-03252 5D

Heavy Metals in Flowing Waters and River Sediments of the Western Harz Region (Schwermetalle in Den Fliessgewassern Und Flusssedimenten Des West-Harzes,
W83-03457 5B

INDUSTRIAL WATER
Efficient Utilization of Industrial Waster and Waste Heat for Intensive Fish Production (Die Rationelle Nutzung Von Industriewasser Und Abwarme Fur Eine Intensive Fischproduktion),
W83-03221 3C

Reuse of Treated Municipal Wastewater in the Technical Supply of Industrial Companies in Moscow (Die Wiederverwendung Des Gereinigten Kommunalen Abwasser In Der Technischen Wasserversorgung Der Moskauer Industriebetriebe),
W83-03222 5D

Problems of the Load at Veb Zellstoff-Und Papierfabrik Rosenthal (Probleme Der Abwasserlast Im Veb Zellstoff-Und Papierfabrik Rosenthal),
W83-03223 5D

INFILTRATION
The Extent and Nature of Rainfall-Soil Interaction in the Release of Soluble Chemicals to Runoff,
W83-03170 5B

Groundwater Purification by Infiltration of Ozonized Water (Grundwassersanierung Durch Infiltration Von Ozontem Wasser),
W83-03200 5G

INFILTRATION RATES
Effects of Surface Application of Dairy Manure on the Infiltration Rate and Quality of Surface Runoff,
W83-03344 5B

INFRARED ANALYSIS
The Fate of Antifoulant Organotin Compounds in Water Systems,
W83-03315 5B

INFRARED IMAGRY
Forecasting Methods in the Future Supply Area of the Rheintal Water Transmission Network (Beweissicherungsverfahren Im Kunftigen Wassergewinnungsgebiet Des Zweckverbands Fernwasserversorgung Rheintal (FWR),
W83-03456 3F

INSECT CONTROL
The Effect of Hormonal Pollutants on Aquatic Crustacea and the Surrounding Environment,
W83-03314 5C

INSECT GROWTH REGULATIONS
The Effect of Hormonal Pollutants on Aquatic Crustacea and the Surrounding Environment,
W83-03314 5C

INSECTICIDES
The Effect of Hormonal Pollutants on Aquatic Crustacea and the Surrounding Environment,
W83-03314 5C

INSTITUTIONAL SUPPORT STRUCTURE
The Impact of Institutional Structure and Citizen Participation on Water Resource Planning in Western Kansas,
W83-03330 6D

INSTREAM FLOW
Adapting Appropriation Water Law to Accommodate Equitable Consideration of Instream Flow Uses,
W83-03379 6E

INTERFACES
Reliability and Verification of Geohydrologic Models (Zuverlassigkeit Und Verifikation Von Geohydrologischen Modellen),
W83-03448 2F

INTERSTATE COMPACTS
Flood Loss Reduction Through Interstate Compacts: An Under-Utilized Approach,
W83-03324 6F

The Escatawpa River - An Interstate Approach to Water Resource Management,
W83-03354 6E

INTERSTATE RIVERS
Flood Loss Reduction Through Interstate Compacts: An Under-Utilized Approach,
W83-03324 6F

The Escatawpa River - An Interstate Approach to Water Resource Management,
W83-03354 6E

INVERTEBRATES
Ecological Assessment of Water Quality: Comparison of Biological-Ecological Procedures in a Rain-Fed Lowland Waterway (Kleine Nete, N. Belgium),
W83-03214 5C

The Biota of Oklahoma Springs: Natural Biological Monitoring of Groundwater Quality,
W83-03347 2H

Agricultural Stream Ecosystems: Structure and Function for Understanding Water Quality Improvements,
W83-03377 6G

Zoobenthos of Lakes of Black Sea Reservation (Preserve),
W83-03479 2H

IODINE
Determination of Total Iodine and Iodate-Iodine in Natural Freshwater,
W83-03206 5A

ION EXCHANGE
Advanced Wastewater Treatment by Ion Exchange,
W83-03196 5D

Removal of Nitrate, Sulfate and Hardness from Groundwater by Ion Exchange,
W83-03290 5F

IOWA
Distributed Source Model for Pesticides in the Iowa River,
W83-03186 5B

Molecular Size Determination of Chloroform Precursors,
W83-03187 5A

Effect of Incorporation of Fall-Applied Fertilizer on Runoff Losses of Nutrients and Soil From Soybean Ground,
W83-03298 2J

Artificial Destratification to Prevent Winterkill,
W83-03299 5G

A Survey of Water Transparency in Iowa Lakes,
W83-03371 5C

IRON
Effect of Iron as a Trace Impurity on the Water Softening Process,
W83-03411 5F

Aggregation of Collodial Iron During Estuarine Mixing: Kinetics, Mechanism, and Seasonality,
W83-03450 2L

IRON COMPOUNDS
Pyrite and Oxidized Iron Mineral Phases Formed from Pyrite Oxidation in Salt Marsh and Estuarine Sediments,
W83-03451 2L

IRRIGATED LAND
Landsat Monitoring of Irrigated Farmland Acreage in Curry County, New Mexico,
W83-03310 7A

IRRIGATION
The Evolution of California State Water Planning 1850-1928,
W83-03274 6E

Efficient Use of Water for Irrigation in the Upper Midwest,
W83-03282 6D

Surface Irrigation as Affected by Ash from Mount St. Helens,
W83-03285 2J

Wind Energy for Low Head Irrigation,
W83-03309 8C

The Impact of Institutional Structure and Citizen Participation on Water Resource Planning in Western Kansas,
W83-03330 6D

Expansion Potential for Irrigation Within the Mississippi Delta Region,
W83-03345 6B

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigtion. Part 3: Canadian, North Canadian, and Deep Fork River Basins through 1979,
W83-03362 7C

A Method for Applying Crop Sensitivity Factors in Irrigation Scheduling,
W83-03384 3F

IRRIGATION EFFECTS
Technology Assessment of Irrigation Scheduling and Crop Response,
W83-03488 3F

IRRIGATION EFFICIENCY
Agricultural Irrigation Technology Transfer Assessment,
W83-03281 3F

Water and Energy Conservation Using Center Pivot Irrigation and Reduced Tillage Systems,
W83-03342 3F

Analysis of Basin Irrigation Performance with Variable Inflow Rate,
W83-03410 3F

IRRIGATION PRACTICES
Effect of Irrigation and Harvesting Dates on the Yield of Spring-Sown Sugar-Beet,
W83-03383 3F

A Method for Applying Crop Sensitivity Factors in Irrigation Scheduling,
W83-03384 3F

Problems of Irrigated Agriculture in Al-Hassa, Saudi Arabia,
W83-03391 3C

Irrigation Water Conservation by Using Wide-Spaced Furrows,
W83-03408 3F

Technology Assessment of Irrigation Scheduling and Crop Response,
W83-03488 3F

IRRIGATION SCHEDULING
Technology Assessment of Irrigation Scheduling and Crop Response,
W83-03488 3F

IRRIGATION WATER
Irrigation Water Response Function Estimation: An Improved Ridge Regression Methodology,
W83-03302 6D

Optimum Irrigation Loading Rates of Highly Saline Wastewater on a Montmorillonitic Soil,
W83-03327 3C

IRRIGATION WATER TYPES
A Computer Model for Predicting the Impact of Irrigating with Saline Water on Soils and Runoff Water in Missouri,
W83-03284 3C

ISOTOPE FRACTIONATION
Extreme Fractionation of U234/U238 and TH230/U234 in Spring Waters, Sediments, and Fossils at the Pomme De Terre Valley, Southwestern Missouri,
W83-03209 2K

ISOTOPE STUDIES
Methodologies for Extraction of Dissolved Inorganic Carbon for Stable Carbon Isotope Studies: Evaluation and Alternatives,
W83-03359 2K

ISRAEL
The Uptake of Dissolved Nitrogenous Nutrients by Lake Kinneret (Israel) Microplankton,
W83-03260 2H

ITALY
Effect of Irrigation and Harvesting Dates on the Yield of Spring-Sown Sugar-Beet,
W83-03383 3F

Drinking Water Contamination with Chloro-Organic Compounds: Sources, Health Effects, Control (Contaminazione Delle Acque Potabili Da Composti Cloro-Organici: Origine, Effetti Biologici, Misure Di Protezione E Di Controllo),
W83-03476 5F

Physical, Chemical, and Biological Characteristics of Lake Omodeo, Part II: Possibility of Using Impounded Water for Supplying Oristano City (Fenomeni Biologici Di Un Lago Artificiale Di Antica Data: Lago Omodeo, Nota II: Sulla Possibilita Di Utilizzare Le Acque Dell'Invaso Per La Alimentazione Idrica Della Citta Di Oristano),
W83-03477 5F

Macro and Trace-Elements in Drinking Water and Foods. Part 2 (Macro Ed Oligoelementi Nell'Apporto Idrico Ed Alimentare. Nota 2),
W83-03483 5B

Viral Contamination of Seawater at Messina (Inquinamento Di Natura Virale Delle Acque Di Mare Della Citta'Di Messina),
W83-03484 5B

Relationships Among the Bacteria Indicators of Fecal Pollution in the Water of the River Brenta (Relazioni Tra Gli Indicatori Di Inquinamento Fecale Nelle Acque Del Fiume Brenta)
W83-03485 5A

JAMES BAY
Aquatic Ecology Monitoring Network of the James Bay Power Co. (Le Reseau De Surveillance D'Ecologie Aquatique De La Societe D'Energie De La Baie James),
W83-03394 6G

JAPAN
Water Mixing in a Tidal Current and the Effect of Turbulence on Tidal Exchange Through a Strait,
W83-03159 2L

JETS
Computer Simulation of Local Destratification in Reservoirs,
W83-03279 5G

KANSAS
The Impact of Institutional Structure and Citizen Participation on Water Resource Planning in Western Kansas,
W83-03330 6D

Chemical Effects of Selected Trace-Metals From Sanitary Landfill Leachates on Groundwater Quality,
W83-03340 5E

KENTUCKY
Hydrology of Area 14, Eastern Coal Province, Kentucky,
W83-03355 7C

KENYA
Meromixis in an Equatorial African Soda Lake,
W83-03254 2H

KINETICS
Modification of Pollutant Hydrolysis Kinetics in the Presence of Humic Substances,
W83-03193 5B

Free Ionic Nickel Accumulation and Localization in the Freshwater Zooplankter, Daphnia Magna,
W83-03256 5B

Particulate Matter Resuspension Via Metabolically Produced Gas Bubbles From Benthic Estuarine Microalgae Communities,
W83-03261 2L

KOREA
A Methodology for Algal Population Study of Periphyton: Measurement of Covering Rate (Une Methodologie Pour L Etude Des Populations Algales Du Periphyton: La Mesure Du Taux De Recouvrement),
W83-03407 5A

LABORATORY ANIMALS
Hygienic Evaluation of Hydrogen Sulfide-Containing Thermal Waters Used in Hot Water Supply Systems (Gigiena Otsenka Serovodnykh Termal'Nykh Vod, Ispol'Zuemykh V Sisteme Goryachego Vodosnabzheniya),
W83-03405 5C

LAKE BASINS
The Costs and Benefits of Soil Erosion Control in the North Lake Chicot Watershed,
W83-03331 4D

LAKE MEAD
Use of Seepage Meters and Mini-Piezometers for Identification of Reservoir - Groundwater Interactions in Lake Mead, Nevada,
W83-03487 7B

LAKE MICHIGAN
Numerical Simulation of Land-Breeze-Induced Snowbands Along the Western Shore of Lake Michigan,
W83-03482 2C

LAKE MORPHOMETRY
Meromixis in an Equatorial African Soda Lake,
W83-03254 2H

LAKE RESTORATION
Artificial Destratification to Prevent Winterkill,
W83-03299 5G

LAKE SEDIMENTS
Post-Mining Neutralization of Acidic Surface Mine Lakes,
W83-03278 5B

LAKES
The Potential for Acid Precipitation Damage to Lakes of the Sierra Nevada, California,
W83-03182 5B

The Zurich Water Supply System,
W83-03229 5F

The Uptake of Dissolved Nitrogenous Nutrients by Lake Kinneret (Israel) Microplankton,
W83-03260 2H

A Study of Eutrophication and Aquatic Plants Growths in Selected Lakes and Rivers of Puerto Rico,
W83-03300 5C

The Groundwater Budget of Lake Wingra, Dane County, Wisconsin,
W83-03305 2F

An Evaluation of Proposed Cage Fish Culture on Loch Lomond, An Important Reservoir in Central Scotland,
W83-03403 6G

Physical, Chemical, and Biological Characteristics of Lake Omodeo, Part II: Possibility of Using Impounded Water for Supplying Oristano City (Fenomeni Biologici Di Un Lago Artificiale Di Antica Data: Lago Omodeo, Nota II: Sulla Possibilita Di Utilizzare Le Acque Dell'Invaso Per La Alimentazione Idrica Della Citta Di Oristano),
W83-03477 5F

Numerical Simulation of Land-Breeze-Induced Snowbands Along the Western Shore of Lake Michigan,
W83-03482 2C

LAND APPRAISALS
Use of Hedonic Price Technique to Evaluate Wetlands,
W83-03343 6B

LAND DISPOSAL
Priority Pollutants in Municipal Sewage Sludge, Part II,
W83-03406 5E

Chemical Speciation of Leachates From Waste Disposal Sites,
W83-03432 5B

LAND MANAGEMENT
Effects of Increased Precipitation and Grazing Management on Northeastern Montana Rangelands,
W83-03174 4D

Optimum Irrigation Loading Rates of Highly Saline Wastewater on a Montmorillonitic Soil,
W83-03327 3C

Soil Conservation and the Reduction of Erosion and Sedimentation in the Coon Creek Basin, Wisconsin,
W83-03356 4D

LAND USE
Influence of Land Utilization on Hydrocarbon Runoff Pollution,
W83-03156 5B

An Economic Analysis of the Devils Lake Basin and Proposed Land Use,
W83-03270 6B

Index Construction for Multiple Objective Analysis of Land and Water Use in a High Mountain Watershed,
W83-03286 6A

Agricultural Stream Ecosystems: Structure and Function for Understanding Water Quality Improvements,
W83-03377 6G

LANDFILLS
Physiochemical Pretreatment of Landfill Leachates Using Coagulation,
W83-03172 5G

Identification and Assessment of Effluent Residuals in Treated Leachate from Landfill Disposal Sites,
W83-03272 5E

LANDSAT SATELLITE
Landsat Monitoring of Irrigated Farmland Acreage in Curry County, New Mexico,
W83-03310 7A

LEACHATE
Identification and Assessment of Effluent Residuals in Treated Leachate from Landfill Disposal Sites,
W83-03272 5E

Effects of Coal Pile Runoff on Stream Quality and Macro-Invertebrate Communities,
W83-03307 5C

LEACHATES
Physiochemical Pretreatment of Landfill Leachates Using Coagulation,
W83-03172 5G

Chemical Effects of Selected Trace-Metals From Sanitary Landfill Leachates on Groundwater Quality,
W83-03340 5E

Organics Transported Through Selected Geologic Media: Assessment of Organics Transported Away From Industrial Waste Disposal Sites,
W83-03375 5A

Chemical Speciation of Leachates From Waste Disposal Sites,
W83-03432 5B

LEACHING
Developments, Recommendations and Applications of Tests for Evaluating the Chemical Stability of High-Level Radioactive Solid Waste Forms,
W83-03427 5B

LEAD
Lead and Other Trace Metals in the Sediments and Selected Biota of Princess Royal Harbour, Albany, Western Australia,
W83-03399 5B

LEAD RADIOISOTOPES
Post-Mining Neutralization of Acidic Surface Mine Lakes,
W83-03278 5B

LEAK LOCATION
Promising Experiments on Leak Location by Means of Correlation (Aussichtsreiche Versuche Zur Leckortung Mittels Korrelation),
W83-03445 5F

LEAKAGE
Promising Experiments on Leak Location by Means of Correlation (Aussichtsreiche Versuche Zur Leckortung Mittels Korrelation),
W83-03445 5F

LEAVES
Production and Decomposition of Forest Litter Fall on the Apalachicola River Flood Plain, Florida,
W83-03364 5B

LEGAL ASPECTS
Overview of Groundwater Law and Institutions in United States Border States,
W83-03496 6E

California Groundwater Management: The Sacred and the Profane,
W83-03498 6E

LEGISLATION
Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

LITTORAL ZONE
Hydrobiology of the Littoral Zone of the Dnieper Estuary Under Conditions of Regulated Flow of the River,
W83-03480 6G

LONG ISLAND SOUND
Concentration, Reactivity and Fate of Copper, Nickel, and Zinc Associated with a Cooling-Water Plume in Estuarine Waters, II. The Particulate Phase,
W83-03398 5B

MACROINVERTEBRATE
Water Quality of the Upper Spokane River and Evaluation of Methods for Measurement of the Effect of Effluent Upon Primary and Secondary Producers,
W83-03317 5A

MACROINVERTEBRATES
Sampling Macrofauna in Ditches,
W83-03217 7B

MACROPHYTES
Effect of Aquatic Macrophytes on Physico-Chemical Parameters of Agricultural Drainage Water,
W83-03153 5G

MAINE
Radon-222 in Potable Water Supplies in Maine: The Geology, Hydrology, Physics and Health Effects,
W83-03308 2K

MANAGEMENT
Multiple Use Reservoir Planning Approaches: Lac Seul, Northwestern Ontario,
W83-03211 6A

Citizen Participation in the Design and Management of Reservoirs,
W83-03418 6A

Multipurpose Use of an Eutrophic South African Man-Made Reservoir,
W83-03425 6D

MANITOBA
Forests, Wetlands and Waterfowl Populations in the Turtle Mountains of North Dakota and Manitoba,
W83-03181 2L

MANURE
Effects of Surface Application of Dairy Manure on the Infiltration Rate and Quality of Surface Runoff,
W83-03344 5B

MARINE BACTERIA
Chesapeake Bay Nutrient and Plankton Dynamics. 1. Bacterial Biomass and Production During Spring Tidal Destratification in the York River, Virginia, Estuary,
W83-03264 2L

MARSHES
The Role of Delaware River Freshwater Tidal Wetlands in the Retention of Nutrients and Heavy Metals,
W83-03169 2L

Pyrite and Oxidized Iron Mineral Phases Formed from Pyrite Oxidation in Salt Marsh and Estuarine Sediments,
W83-03451 2L

MARYLAND
Composition of Estuarine Colloidal Material: Organic Components,
W83-03202 2L

Effects of Coal Pile Runoff on Stream Quality and Macro-Invertebrate Communities,
W83-03307 5C

MASS SPECTROMETRY
Deuterium as a Tracer in the Groundwater Study of a Central North Dakota Mining Area,
W83-03177 5A

MASSACHUSETTS
Use of Hedonic Price Technique to Evaluate Wetlands,
W83-03343 6B

The Flood Mitigation Potential of Inland Wetlands,
W83-03349 6A

MATHEMATICAL MODELS
Mathematical Model for Long-Term Water Supply Planning (Mathematisches Modell Fur Die Langfristige Wasserversorgungsplanung),
W83-03224 6A

Reliability and Verification of Geohydrologic Models (Zuverlassigkeit Und Verifikation Von Geohydrologischen Modellen),
W83-03448 2F

Mathematical Modeling in Urban Hydrology,
W83-03486 2A

A Modified Sediment Transport Model for Natural Streams,
W83-03494 2J

MATHEMATICAL STUDIES
Backwater Curve Computations Under Ice Covers in the La Grande River (Courbes De

Remous Sous Les Couverts De Glace De La Grande Riviere),
W83-03395 2C

Modified Monthly Minimum Method for Rapid Calculation of Groundwater Recharge from Receiving Stream Runoff (Das Modifizierte Verfahren MoMNO (r12) Zur Raschen Ermittlung Der Grundwasserneubildungsrate Aus Dem Vorfluterabfluss),
W83-03447 2F

Improved Formulas for Estimating Groundwater Supplies by Short-Term Precipitation-Minimum Series (Verbesserte Ansatza Fuer Die Schatzung Der Dargebote Von Grundwassermengen Durch Niederschlags-Minimum-Kurzreihen),
W83-03461 2A

MEASURING INSTRUMENTS
Contribution to the Measurement of Evaporation in Remote Stations (Beitrag Zur Verdunstungsmessung in Abgelegenen Stationen),
W83-03225 7B

Opportunities and Potential Benefits of Radar Rainfall Measurements for the Federal Republic of Germany (Moglichkeiten und Potentieller Nutzen Eines Bundesdeutschen Niederschlagsradar--Verbundsystems),
W83-03240 7B

Hydraulic Criteria for the Design of Weir Sills (Hydraulische Entwurfs- Und Bemessungskriterien fur Sohlschwellen),
W83-03241 8B

On The Esimation of the Error of Soil Moisture Measurement by Means of a Neutron Scattering Probe (Zur Abschatzung Des Fehlers Der Bodenfeuchte-Messung Mit Einer Neutronensonde),
W83-03242 7B

MECHANICAL EQUIPMENT
Water Plant Grows Bigger, Cuts Electric Bill.
W83-03226 5F

Returning the Tyne to Life,
W83-03231 5D

Centrifugal Pump Basics,
W83-03258 8C

MEMBRANE PROCESSES
Final Results of Testing of Abcor 8 Inches Spiral Wound Ultra-Filters at The Wrightsville Beach Test Facility,
W83-03288 3A

MERCURY
Industrial Effluents as a Source of Mercury Contamination in Terrestrial Riparian Vertebrates,
W83-03402 5B

MEROMIXIS
Meromixis in an Equatorial African Soda Lake,
W83-03254 2H

METABOLISM
Development of a Cell Culture Screen for Water Toxicity,
W83-03306 5A

METAL COMPLEX SEPARATION
Determination of the Complexing Capacity of Water Systems by Gel Chromatographic and Electrochemical Techniques,
W83-03185 5A

METAL FINISHING WASTES
Polarographic Determination of Low Levels of Cyanide and Metals in the Waste-Waters Discharged by an Electroplating Plant (Dosages Polarographiques de Faibles Quantities D'Ions Cyanure et de Metaux Dans Les Euax Rejetees Par un Atelier de Galvanoplastie),
W83-03412 5A

METALS
The Role of Delaware River Freshwater Tidal Wetlands in the Retention of Nutrients and Heavy Metals,
W83-03169 2L

The Role of Fulvic Substances on Trace Metal Partitioning in Natural Aquatic Sediments,
W83-03348 2K

Recovery and Transport of Heavy Metals by Spartina Alterniflora From Dredging Spoils,
W83-03381 2L

Concentration, Reactivity and Fate of Copper, Nickel, and Zinc Associated with a Cooling-Water Plume in Estuarine Waters, II. The Particulate Phase,
W83-03398 5B

Lead and Other Trace Metals in the Sediments and Selected Biota of Princess Royal Harbour, Albany, Western Australia,
W83-03399 5B

Trace Elements (Manganese, Zinc and Copper) in the USSR Part of the Danube River,
W83-03470 5B

METEOROLOGICAL DATA COLLECTION
Improved Formulas for Estimating Groundwater Supplies by Short-Term Precipitation-Minimum Series (Verbesserte Ansatza Fuer Die Schatzung Der Dargebote Von Grundwassermengen Durch Niederschlags-Minimum-Kurzreihen),
W83-03461 2A

METROPOLITAN WATER MANAGEMENT
Water Industry Accountability Through the Ombudsman System,
W83-03233 6E

MEXICO
Water-Its Role From Now to the Year 2000,
W83-03491 6D

Anticipating Transboundary Water Needs and Issues in the Mexico-United States Border Region in the Rio Grande Basin,
W83-03495 6D

Trans-Boundary Geothermal Resources of Texas and Mexico,
W83-03499 2F

Surface Water Quality in the Border Area Between El Paso and the Gulf of Mexico,
W83-03500 5G

MICROBIAL DEGRADATION
Biodegradation of 1,3-Dinitrobenzene,
W83-03155 5B

MICROBIOLOGY
New Approaches to Measuring Total Bacterial Populations in Water Supplies,
W83-03292 5A

MICROSCOPIC ANALYSIS
A Methodology for Algal Population Study of Periphyton: Measurement of Covering Rate (Une Methodologie Pour L Etude Des Populations Algales Du Periphyton: La Mesure Du Taux De Recouvrement),
W83-03407 5A

MICROSCOPY
A Methodology for Algal Population Study of Periphyton: Measurement of Covering Rate (Une Methodologie Pour L Etude Des Populations Algales Du Periphyton: La Mesure Du Taux De Recouvrement),
W83-03407 5A

MINE DRAINAGE
Control of Trihalomethanes in Barcelona's Water Supply (Controle Des Trihalomethanes Dans Les Eaux D'Approvisionnement De Barcelone),
W83-03210 5B

Investigative Programs for Designing and Modeling Mine Water Control Systems,
W83-03265 4B

Effects of Coal Pile Runoff on Stream Quality and Macro-Invertebrate Communities,
W83-03307 5C

MINERAL WATER
'Geothermal Mineral Equilibria.' Reply to a Comment by M. A. Grant,
W83-03416 2K

On the Lack of a Unique Relation Between C02 Partial Pressure and Temperature in Geothermal System. Comment on 'Geothermal Mineral Equilibria' by W. F. Giggenbach,
W83-03434 2K

MINERALS
The Chemistry of Geothermal Waters in Iceland. I. Calculation of Aqueous Specification from 0 to 370C,
W83-03201 2K

MINING ENGINEERING
Investigative Programs for Designing and Modeling Mine Water Control Systems,
W83-03265 4B

MISSISSIPPI
The Escatawpa River - An Interstate Approach to Water Resource Management,
W83-03354 6E

MISSISSIPPI DELTA REGION
Expansion Potential for Irrigation Within the Mississippi Delta Region,
W83-03345 6B

MISSOURI
Extreme Fractionation of U234/U238 and TH230/U234 in Spring Waters, Sediments, and Fossils at the Pomme De Terre Valley, Southwestern Missouri,
W83-03209 2K

A Computer Model for Predicting the Impact of Irrigating with Saline Water on Soils and Runoff Water in Missouri,
W83-03284 3C

MIXING
Water Mixing in a Tidal Current and the Effect of Turbulence on Tidal Exchange Through a Strait,
W83-03159 2L

Water Plant Grows Bigger, Cuts Electric Bill.
W83-03226 5F

Chesapeake Bay Nutrient and Plankton Dynamics. 1. Bacterial Biomass and Production During Spring Tidal Destratification in the York River, Virginia, Estuary,
W83-03264 2L

Computer Simulation of Local Destratification in Reservoirs,
W83-03279 5G

Experimental and Analytical Study of Heat Transfer and Mixing in Thermally Stratified Buoyant Flows,
W83-03370 2H

Aggregation of Collodial Iron During Estuarine Mixing: Kinetics, Mechanism, and Seasonality,
W83-03450 2L

MODEL STUDIES
The Removal of Salmonella Enteritidis in Activated Sludge,
W83-03152 5D

Distributed Source Model for Pesticides in the Iowa River,
W83-03186 5B

Field Evaluation of a Water Management Simulation Model,
W83-03238 4A

Water and Sewer System Modelling Using a Micro-Computer System,
W83-03243 5F

Modelling the Flood Alleviation Scheme for the Usk at Brecon,
W83-03247 8B

The Groundwater Budget of Lake Wingra, Dane County, Wisconsin,
W83-03305 2F

Aquaculture Techniques: A Production Forecasting Model for Aquaculture Systems,
W83-03318 8I

Sediment Deposition Model for Reservoirs Based on the Dominant Physical Processes,
W83-03417 2J

Reliability and Verification of Geohydrologic Models (Zuverlassigkeit Und Verifikation Von Geohydrologischen Modellen),
W83-03448 2F

Numerical Simulation of Land-Breeze-Induced Snowbands Along the Western Shore of Lake Michigan,
W83-03482 2C

A Modified Sediment Transport Model for Natural Streams,
W83-03494 2J

MOLECULAR WEIGHT
Molecular Size Determination of Chloroform Precursors,
W83-03187 5A

MOLLUSKS
Identification of the Water Quality Factors Which Prevent Fingernail Clams From Recolonizing the Illinois River, Phase III,
W83-03463 5C

MONITORING
Gamekeeper, Poacher--The Welsh Wa Approach,
W83-03219 5F

Monitoring of Groundwater Levels for Real-Time Conjunctive Water Management,
W83-03333 7B

Evaluation and Accessing of Data for a Water Resources Simulator,
W83-03334 7A

Aquatic Ecology Monitoring Network of the James Bay Power Co. (Le Reseau De Surveillance D'Ecologie Aquatique De La Societe D'Energie De La Baie James),
W83-03394 6G

MONTANA
Effects of Increased Precipitation and Grazing Management on Northeastern Montana Rangelands,
W83-03174 4D

Cost and Precision in a Stream Sampling Program,
W83-03336 6C

An Economic Analysis of Obstacles to Water Conservation in Montana Water Law,
W83-03464 4B

A Meteorological and Climatological Approach in Determining Snowpack Accumulation at Snow Course Sites in a Montana Watershed,
W83-03465 2A

MOUNT ST. HELENS
Surface Irrigation as Affected by Ash from Mount St. Helens,
W83-03285 2J

MOUNTAIN LAKES
The Potential for Acid Precipitation Damage to Lakes of the Sierra Nevada, California,
W83-03182 5B

MULTIOBJECTIVE PLANNING
Estimation of the Economic Worth of Water for Release Decisions,
W83-03280 6A

Index Construction for Multiple Objective Analysis of Land and Water Use in a High Mountain Watershed,
W83-03286 6A

MULTIPLE USE RESERVOIR PLANNING
Multiple Use Reservoir Planning Approaches: Lac Seul, Northwestern Ontario,
W83-03211 6A

MUNICIPAL WASTEWATER
Reuse of Treated Municipal Wastewater in the Technical Supply of Industrial Companies in Moscow (Die Wiederverwendung Des Gereinigten Kommunalen Abwasser In Der Technischen Wasserversorgung Der Moskauer Industriebetriebe),
W83-03222 5D

Changes in Esterase Zymograms of a Planktonic Copepod, Acartia Clausi, in a Polluted Marine Area (Sewage Output of Marseilles) (Modifications Des Zymogrammes Des Esterases D'Un Copepode Planctonique, Acartia Clausi Dans Une Emissaire De Marseille),
W83-03386 5C

Costs of Phosphate Elimination in Municipal Wastewater Facilities (Kosten Der Phosphatelimination in Kommunalen Klaranlagen),
W83-03436 5D

MUNICIPAL WATER
Fit to Drink,
W83-03236 5F

MUSSELS
Identification of the Water Quality Factors Which Prevent Fingernail Clams From Recolonizing the Illinois River, Phase III,
W83-03463 5C

Viral Contamination of Seawater at Messina (Inquinamento Di Natura Virale Delle Acque Di Mare Della Citta'Di Messina),
W83-03484 5B

NAVIGABLE RIVERS
Sedimentologic Study of the Mouth of the Gabon River Estuary (Etude Sedimentologique De L'Embouchure De L'Estuaire Du Gabon),
W83-03257 2L

NAVIGATION
Estimation of the Economic Worth of Water for Release Decisions,
W83-03280 6A

NEBRASKA
Conservation of Soil, Water, andd Energy Through Reduced Tillage Systems - Phase I sub 1,
W83-03287 4D

The Biological Regulation of Bloom-Causing Blue-Green Algae: A Feasible Alternative,
W83-03311 5C

Measurement of Actual Transpiration of Native Grass Stands as a Component of Nebraska Sandhills Groundwater Hydrology,
W83-03312 2D

Water and Energy Conservation Using Center Pivot Irrigation and Reduced Tillage Systems,
W83-03342 3F

Managing for Waves on Nebraska's Lake McConaughy - An Overview,
W83-03426 8A

NETHERLANDS
The Influence of Micro-Algae on the Oxygen Dynamics in a Brackish Ditch,
W83-03215 5C

Saline Seepage and Vertical Distribution of Oxygen in a Brackish Ditch,
W83-03216 5C

NETWORKS
Promising Experiments on Leak Location by Means of Correlation (Aussichtsreiche Versuche Zur Leckortung Mittels Korrelation),
W83-03445 5F

NEUTRALIZATION
Post-Mining Neutralization of Acidic Surface Mine Lakes,
W83-03278 5B

NEVADA
Environmental Isotopic and Hydrogeochemical Investigation of Recharge and Subsurface Flow in Eagle Valley, Nevada,
W83-03380 2F

Use of Seepage Meters and Mini-Piezometers for Identification of Reservoir - Groundwater Interactions in Lake Mead, Nevada,
W83-03487 7B

NEW HAMPSHIRE
The Concord Water Survey,
W83-03351 3D

NEW JERSEY
Influence of Land Utilization on Hydrocarbon Runoff Pollution,
W83-03156 5B

The Role of Delaware River Freshwater Tidal Wetlands in the Retention of Nutrients and Heavy Metals,
W83-03169 2L

Water Reuse in the Coastal Plain of New Jersey - A Case Study,
W83-03378 3C

NEW MEXICO
Landsat Monitoring of Irrigated Farmland Acreage in Curry County, New Mexico,
W83-03310 7A

An Evaluation of Sediments in the Middle Rio Grande, Elephant Butte Reservoir, and Caballo Reservoir as Potential Sources for Toxic Meterials,
W83-03322 5B

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-5A, H-5B, and H-5C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03360 2K

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-6A, H-6B, and H-6C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03361 2K

Effects of Coal Burning in New Mexico on Air Quality and Surface Water Quality: Raton Study Area,
W83-03382 2K

New Mexico Water Law: An Overview and Discussion of Current Issues,
W83-03492 6E

Water Availability in the New Mexico Upper Rio Grande Basin to the Year 2000,
W83-03493 6D

NEW YORK
Mother Nature as Sludge Thickener,
W83-03227 5F

NEWFOUNDLAND
Development of a Reservoir Preparation Strategy,
W83-03420 6G

NICKEL
Free Ionic Nickel Accumulation and Localization in the Freshwater Zooplankter, Daphnia Magna,
W83-03256 5B

NITRATES
The Uptake of Dissolved Nitrogenous Nutrients by Lake Kinneret (Israel) Microplankton,
W83-03260 2H

The Movement of Nitrates, Phosphates, and Fecal Coliform Bacteria From Disposal Systems Installed in Selected Connecticut Soils,
W83-03276 5B

Removal of Nitrate, Sulfate and Hardness from Groundwater by Ion Exchange,
W83-03290 5F

Photoinduced Hydroxylation Reactions of Organic Chemicals in Natural Waters, Nitrates as Potential OH Radical Sources (Photoinduzierte Hydroxylierungsreaktionen Organischer Chemikalien in Naturlichen Gewassern, Nitrate Als Potentielle Oh-Radikalquellen),
W83-03385 5B

NITRITES
Accuracy of Determination of Total Oxidised Nitrogen and Nitrite in River Waters: Analytical Quality Control in the Harmonised Monitoring Scheme.
W83-03207 5A

NITROGEN
Accuracy of Determination of Total Oxidised Nitrogen and Nitrite in River Waters: Analytical Quality Control in the Harmonised Monitoring Scheme.
W83-03207 5A

The Uptake of Dissolved Nitrogenous Nutrients by Lake Kinneret (Israel) Microplankton,
W83-03260 2H

Influence of Agricultural Drainage on Water Quality,
W83-03289 5B

NITROGEN FIXATION
In Situ Nitrogen (C2H2) Fixation in Lakes of Southerm Victoria Land, Antarctica,
W83-03203 2H

NOMOGRAMS
Cost and Precision in a Stream Sampling Program,
W83-03336 6C

NON-POINT POLLUTION SOURCES
Effects of Surface Application of Dairy Manure on the Infiltration Rate and Quality of Surface Runoff,
W83-03344 5B

Fecal Coliform Release Studies and Development of a Preliminary Nonpoint Source Transport Model for Indicator Bacteria,
W83-03376 5B

NON-STRUCTURAL ALTERNATIVES
Flood Loss Reduction Through Interstate Compacts: An Under-Utilized Approach,
W83-03324 6F

NONPOINT POLLUTION SOURCES
Distributed Source Model for Pesticides in the Iowa River,
W83-03186 5B

Water Quality of Airport Storm Runoff,
W83-03353 5B

NONPOINT SOURCE WATER POLLUTION
Quantitative Models and Analysis of Urban Nonpoint Source Water Pollution Control Systems,
W83-03184 6A

NORTH DAKOTA
Water Storage Capacity of Natural Wetland Depressions in the Devils Lake Basin of North Dakota,
W83-03160 2H

Deuterium as a Tracer in the Groundwater Study of a Central North Dakota Mining Area,
W83-03177 5A

The Phytoplankton Ecology of Devils Lake,
W83-03180 2H

Forests, Wetlands and Waterfowl Populations in the Turtle Mountains of North Dakota and Manitoba,
W83-03181 2L

The Effects of Altered Hydrologic Regime on Tree Growth Along the Missouri River in North Dakota,
W83-03262 6G

An Economic Analysis of the Devils Lake Basin and Proposed Land Use,
W83-03270 6B

Identification and Quantification of Water Soluble Components of Outboard Motor Exhaust and of Gasoline in a North Dakota Lake,
W83-03428 5A

NUCLEAR POWERPLANTS
Studies of Activation Products in the Terrestrial Environments of Three Swedish Nuclear Power Stations,
W83-03397 5B

NUTRIENT REMOVAL
Advanced Wastewater Treatment by Ion Exchange,
W83-03196 5D

NUTRIENT REQUIREMENTS
Control of Algal Dominance Through Changes in Zooplankton Grazing, Lake Washington: Phase I,
W83-03467 5G

NUTRIENTS
Fate of Nitrogen and Phosphorus in a Wastewater Retention Reservoir Containing Aquatic Macrophytes,
W83-03154 5D

Evaluating the Release of Soluble Components from Sediment,
W83-03168 5B

The Role of Delaware River Freshwater Tidal Wetlands in the Retention of Nutrients and Heavy Metals,
W83-03169 2L

A Seasonal Study of the Distributions of Surface State Variables in Liverpool Bay. III. An Offshore Front,
W83-03173 2L

The Uptake of Dissolved Nitrogenous Nutrients by Lake Kinneret (Israel) Microplankton,
W83-03260 2H

Chesapeake Bay Nutrient and Plankton Dynamics. 1. Bacterial Biomass and Production During Spring Tidal Destratification in the York River, Virginia, Estuary,
W83-03264 2L

Effect of Incorporation of Fall-Applied Fertilizer on Runoff Losses of Nutrients and Soil From Soybean Ground,
W83-03298 2J

The Influence of Sample Treatment on Nutrient Analysis in Eutrophic Waters (Der Einfluss Der Probenbehandlung Auf Die Nahrstoffanalytik Bei Eutrophen Gewassern),
W83-03392 5A

OGLIOTROPHIC LAKES
An Experimental Investigation of the Effects of Crude Oil on Two Freshwater Lake Ecosystems,
W83-03273 5C

OHIO
Tufa Precipitation and its Effect on Drainage of Interstate Highways in Northeastern Ohio,
W83-03213 5B

OIL INDUSTRY
Physical, Chemical, and Biological Characteristics of Lake Omodeo, Part II: Possibility of Using Impounded Water for Supplying Oristano City (Fenomeni Biologici Di Un Lago Artificiale Di Antica Data: Lago Omodeo, Nota II: Sulla Possibilita Di Utilizzare Le Acque Dell'Invaso Per La Alimentazione Idrica Della Citta Di Oristano),
W83-03477 5F

OIL POLLUTION
An Experimental Investigation of the Effects of Crude Oil on Two Freshwater Lake Ecosystems,
W83-03273 5C

Development of a Cell Culture Screen for Water Toxicity,
W83-03306 5A

OKLAHOMA
Evaluating the Release of Soluble Components from Sediment,
W83-03168 5B

Estimation of the Economic Worth of Water for Release Decisions,
W83-03280 6A

Development of a Cell Culture Screen for Water Toxicity,
W83-03306 5A

The Biota of Oklahoma Springs: Natural Biological Monitoring of Groundwater Quality,
W83-03347 2H

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigtion. Part 3: Canadian, North Canadian, and Deep Fork River Basins through 1979,
W83-03362 7C

Irrigation Water Conservation by Using Wide-Spaced Furrows,
W83-03408 3F

ON-LOT SEWAGE DISPOSAL
On-Site Sewage Disposal: Site Suitability, System Selection and Soil Absorption Area Sizing,
W83-03268 5D

ON-SITE SEWAGE DISPOSAL
On-Site Sewage Disposal: Site Suitability, System Selection and Soil Absorption Area Sizing,
W83-03268 5D

ONTARIO
Aquatic Plant Control and Disappearance of Terbutryn from Treated Waters in Ontario, Canada, 1974-1977,
W83-03166 4A

Multiple Use Reservoir Planning Approaches: Lac Seul, Northwestern Ontario,
W83-03211 6A

Fisheries Productivity and Water Level Fluctuations in Lac Seul, Northwestern Ontario,
W83-03212 6G

Prechlorination and Trihalomethane Formation at Water Treatment,
W83-03228 5F

OPERATING COSTS
Mathematical Model for Long-Term Water Supply Planning (Mathematisches Modell Fur Die Langfristige Wasserversorgungsplanung),
W83-03224 6A

Costs of Phosphate Elimination in Municipal Wastewater Facilities (Kosten Der Phosphatelimination in Kommunalen Klaranlagen),
W83-03436 5D

OPERATING POLICIES
A Method for Calculating the Dimensions of Long Sewage Force Mains,
W83-03199 5D

The Meaning of the Generally Accepted Technological Standards for the Planning, Construction, and Operation of Water Distribution Facilities (Die Bedeutung Der Anerkannten Regeln Der Technik Fur Planung, Bau und Betrieb Von Wasserversorgungsanlagen),
W83-03441 6E

OPTIMIZATION
Real-Time Forecasting of River Flows and Stochastic Optimal Control of Multireservoir Systems,
W83-03323 4A

Optimization and Dynamic Control of the Coagulation Process in Water Treatment,
W83-03373 5F

Monitoring Flocculation in Water Treatment Using a Computer-Controlled Physical Model (Uberwachung der Wasseraufbereitung Mit Hilfe Eines Rechnergesteuerten Physikalischen Modells),
W83-03439 5F

OREGON
Dynamic Modelling of Suspended Sediment Transport in Streams as a Function of Sediment Supply,
W83-03368 2J

Comparison of Reservoirs with Dissimilar Selective Withdrawal Capabilities: Effects on Reservoir Limnology and Release Water Quality,
W83-03422 5G

A Public Participation Decision to Fill a Pacific Northwest Reservoir,
W83-03423 6D

OREGON ECONOMY
Toward an Econometric Model to Analyze Impacts of Water Availability on the Oregon Economy,
W83-03326 6A

ORGANIC CARBON
Molecular Size Determination of Chloroform Precursors,
W83-03187 5A

ORGANIC COMPOUNDS
Molecular Size Determination of Chloroform Precursors,
W83-03187 5A

Removal of Trace Chlorinated Organic Compounds by Activated Carbon and Fixed-Film Bacteria,
W83-03194 5D

Identification and Assessment of Effluent Residuals in Treated Leachate from Landfill Disposal Sites,
W83-03272 5E

Organics Transported Through Selected Geologic Media: Assessment of Organics Transported Away From Industrial Waste Disposal Sites,
W83-03375 5A

Photoinduced Hydroxylation Reactions of Organic Chemicals in Natural Waters, Nitrates as Potential OH Radical Sources (Photoinduzierte Hydroxylierungsreaktionen Organischer Chemikalien in Naturlichen Gewassern, Nitrate Als Potentielle Oh-Radikalquellen),
W83-03385 5B

Identification and Quantification of Water Soluble Components of Outboard Motor Exhaust and of Gasoline in a North Dakota Lake,
W83-03428 5A

Organic Matter Pollution of Groundwater Near Highways (Belastung Des Grundwassers Mit Organischen Stoffen Im Gebiet Von Strassen),
W83-03446 5B

ORGANIC MATTER
Composition of Estuarine Colloidal Material: Organic Components,
W83-03202 2L

Production and Decomposition of Forest Litter Fall on the Apalachicola River Flood Plain, Florida,
W83-03364 5B

Aggregation of Collodial Iron During Estuarine Mixing: Kinetics, Mechanism, and Seasonality,
W83-03450 2L

Material and Energy Balance of Organic Matter in the Waters of the Rybinsk Reservoir and Lake Baikal,
W83-03478 2H

ORGANIC PESTICIDES
An Evaluation of Sediments in the Middle Rio Grande, Elephant Butte Reservoir, and Caballo Reservoir as Potential Sources for Toxic Meterials,
W83-03322 5B

ORGANOTIN COMPOUNDS
The Fate of Antifoulant Organotin Compounds in Water Systems,
W83-03315 5B

OSMOTIC PRESSURE
Chemostat Adaptation of Escherichia Coli B/r/1 to Low Water Activity,
W83-03151 5D

OUTBOARD MOTOR EXHAUST
Identification and Quantification of Water Soluble Components of Outboard Motor Exhaust and of Gasoline in a North Dakota Lake,
W83-03428 5A

OUTFALL SEWERS
Viral Contamination of Seawater at Messina (Inquinamento Di Natura Virale Delle Acque Di Mare Della Citta'Di Messina),
W83-03484 5B

OXIDATION
Wet Oxidation for the Treatment of Toxic Industrial Wastes.
W83-03235 5D

OXYGEN
The Influence of Micro-Algae on the Oxygen Dynamics in a Brackish Ditch,
W83-03215 5C

Biological Wastewater Purification with Technical Oxygen (Biologische Abwasserreinigung Mit Techn. Reinem Sauerstoff),
W83-03443 5D

OXYGEN DEMAND
Saline Seepage and Vertical Distribution of Oxygen in a Brackish Ditch,
W83-03216 5C

Nutrient Contents and Algal Growth in an Impounded River: Effects on Oxygen Balance and need for Nutrient Retention (Nahrstoffgehalte und Algenwachstum in Einem Gestauten Fluss, Auswirkungen Auf Die Sauerstoffbilanz Und Notwendigkeit Des Nahrstoffruckhaltes),
W83-03454 5C

OYSTER LARVAE
The Effect of Aufwuchs Copper on Spat Settlement of the Oyster, Crassostrea Virginica,
W83-03429 5C

OZONATION
UV-Ozone Process for the Concurrent Decomposition of Halogenated Alkanes and the Disinfection of Water,
W83-03338 5F

PANAMA
Effect of Hydout and Aquathol K on Hydrilla in Gatun Lake, Panama,
W83-03162 4A

PARASITES
Management of Human Excreta,
W83-03191 5D

PARTICULATE MATTER
Particulate Matter Resuspension Via Metabolically Produced Gas Bubbles From Benthic Estuarine Microalgae Communities,
W83-03261 2L

Concentration, Reactivity and Fate of Copper, Nickel, and Zinc Associated with a Cooling-Water Plume in Estuarine Waters, II. The Particulate Phase,
W83-03398 5B

PATH OF POLLUTANTS
Distributed Source Model for Pesticides in the Iowa River,
W83-03186 5B

An Evaluation of Sediments in the Middle Rio Grande, Elephant Butte Reservoir, and Caballo Reservoir as Potential Sources for Toxic Meterials,
W83-03322 5B

Chemical Effects of Selected Trace-Metals From Sanitary Landfill Leachates on Groundwater Quality,
W83-03340 5E

Chemical-Quality Reconnaissance of the Water and Surficial Bed Material in the Delaware River Estuary and Adjacent New Jersey Tributaries, 1980-81,
W83-03363 2L

Recovery and Transport of Heavy Metals by Spartina Alterniflora From Dredging Spoils,
W83-03381 2L

PATHOGENIC BACTERIA
Barrier Effect of Various Methods for Desalinating Seawater in the Presence of Chemical Pollutants (Obezzarazhivayushchii Effekt Razlichnykh Metodov Opresneniya Morskoi Vody V Usloviyakh ee Khimicheskogo Zagryazneniya),
W83-03404 3A

PENNSYLVANIA
On-Site Sewage Disposal: Site Suitability, System Selection and Soil Absorption Area Sizing,
W83-03268 5D

Johnstown-Western Pennsylvania Storm and Floods of July 19-20, 1977,
W83-03357 2E

PENSTOCKS
Slide Valves Save Costs.
W83-03232 8C

PERCH
Biological Role of Perch in the Kremenchug Reservoir,
W83-03472 2H

PERIPHYTON
Water Quality of the Upper Spokane River and Evaluation of Methods for Measurement of the Effect of Effluent Upon Primary and Secondary Producers,
W83-03317 5A

PERMEABILITY
Undisturbed Core Method for Determining and Evaluating the Hydraulic Conductivity of Unsaturated Sediments,
W83-03319 2G

PESTICIDE KINETICS
Effect of Hydout and Aquathol K on Hydrilla in Gatun Lake, Panama,
W83-03162 4A

PESTICIDE RESIDUES
Effect of Hydout and Aquathol K on Hydrilla in Gatun Lake, Panama,
W83-03162 4A

Aquatic Plant Control and Disappearance of Terbutryn from Treated Waters in Ontario, Canada, 1974-1977,
W83-03166 4A

PESTICIDES
Distributed Source Model for Pesticides in the Iowa River,
W83-03186 5B

The Responses of Plankton Communities in Experimental Ponds to Atrazine, the Most Heavily Used Pesticide in the United States,
W83-03255 5C

PHASE DIAGRAMS
Organic Absorbents for Triple Point Absorption Freeze Crystallization Processes,
W83-03341 3A

PHENOLS
Characterization of Kel-F-Graphite Composite (Kelgraf) Electrodes and Application to Detection in Flowing Streams,
W83-03369 7B

Organics Transported Through Selected Geologic Media: Assessment of Organics Transported Away From Industrial Waste Disposal Sites,
W83-03375 5A

PHOSPHATES
The Movement of Nitrates, Phosphates, and Fecal Coliform Bacteria From Disposal Systems Installed in Selected Connecticut Soils,
W83-03276 5B

PHOSPHORUS
Influence of Agricultural Drainage on Water Quality,
W83-03289 5B

Phosphate Release in Laboratory Soil Columns,
W83-03301 5B

Nutrient Contents and Algal Growth in an Impounded River: Effects on Oxygen Balance and need for Nutrient Retention (Nahrstoffgehalte und Algenwachstum in Einem Gestauten Fluss, Auswirkungen Auf Die Sauerstoffbilanz Und Notwendigkeit Des Nahrstoffruckhaltes),
W83-03454 5C

PHOSPHORUS RECYCLING
Control of Algal Dominance Through Changes in Zooplankton Grazing, Lake Washington: Phase I,
W83-03467 5G

PHYSICOCHEMICAL PROPERTIES
Effect of Aquatic Macrophytes on Physico-Chemical Parameters of Agricultural Drainage Water,
W83-03153 5G

PHYTOPLANKTON
A Seasonal Study of the Distributions of Surface State Variables in Liverpool Bay. III. An Offshore Front,
W83-03173 2L

The Phytoplankton Ecology of Devils Lake,
W83-03180 2H

PIEZOMETERS
The Groundwater Budget of Lake Wingra, Dane County, Wisconsin,
W83-03305 2F

Use of Seepage Meters and Mini-Piezometers for Identification of Reservoir - Groundwater Interactions in Lake Mead, Nevada,
W83-03487 7B

PILOT PLANT
Fabrication of a 6,000 GPD Indirect Freezing Pilot Plant: Vol. 1,
W83-03462 3A

The Start-up and Testing of a 6,000 GPD Indirect Freeze Desalination Pilot Plant,
W83-03468 3A

PILOT PLANT STUDIES
Effect of Precipitation Purification on the Behavior of Sludges During Mechanical Dewatering (Einfluss Der Fallungsreinigung Auf Das Verhalten Von Klarschlammen Bei Der Mechanischen Entwasserung),
W83-03444 5D

PLANKTON
The Responses of Plankton Communities in Experimental Ponds to Atrazine, the Most Heavily Used Pesticide in the United States,
W83-03255 5C

The Uptake of Dissolved Nitrogenous Nutrients by Lake Kinneret (Israel) Microplankton,
W83-03260 2H

PLANNING
Multiple Use Reservoir Planning Approaches: Lac Seul, Northwestern Ontario,
W83-03211 6A

Mathematical Model for Long-Term Water Supply Planning (Mathematisches Modell Fur Die Langfristige Wasserversorgungsplanung),
W83-03224 6A

The Evolution of California State Water Planning 1850-1928,
W83-03274 6E

The Development and Effect of Fish Attractors on the Tennessee-Tombigbee Waterway,
W83-03419 6G

Multi-Purpose Storage Systems: Objective, Conflicts, Alternatives,
W83-03424 6A

PLANT GROWTH INHIBITORS
Efficiency of Water Use by Crops Under Allelopathy Stress,
W83-03313 2I

PLANT WATER BALANCE
Automated Strain Gage Dendrography for Improved Water Utilization in Plants,
W83-03372 2I

POLAROGRAPHIC ANALYSIS
Polarographic Determination of Low Levels of Cyanide and Metals in the Waste-Waters Discharged by an Electroplating Plant (Dosages Polarographiques de Faibles Quantities D'Ions Cyanure et de Metaux Dans Les Euax Rejetees Par un Atelier de Galvanoplastie),
W83-03412 5A

On the Analysis of Trace Elements Harmful to Humans in River Sediments (Zur Analytik Humangefahrlicher Spurenelemente in Flusssediment),
W83-03442 5A

POLLUTANT IDENTIFICATION
Improved Salmonella Recovery from Moderate to Highly Polluted Waters,
W83-03164 5A

Molecular Size Determination of Chloroform Precursors,
W83-03187 5A

Fluorimetric Determination of Chloroform in Drinking Water,
W83-03190 5A

Accuracy of Determination of Total Oxidised Nitrogen and Nitrite in River Waters: Analytical Quality Control in the Harmonised Monitoring Scheme.
W83-03207 5A

Effect of Sunlight on Enumeration of Indicator Bacteria Under Field Conditions,
W83-03291 5A

New Approaches to Measuring Total Bacterial Populations in Water Supplies,
W83-03292 5A

Effects of Coal Pile Runoff on Stream Quality and Macro-Invertebrate Communities,
W83-03307 5C

Radon-222 in Potable Water Supplies in Maine: The Geology, Hydrology, Physics and Health Effects,
W83-03308 2K

The Fate of Antifoulant Organotin Compounds in Water Systems,
W83-03315 5B

Water Quality of the Upper Spokane River and Evaluation of Methods for Measurement of the

Effect of Effluent Upon Primary and Secondary Producers,
W83-03317 5A

Characterization of Kel-F-Graphite Composite (Kelgraf) Electrodes and Application to Detection in Flowing Streams,
W83-03369 7B

Organics Transported Through Selected Geologic Media: Assessment of Organics Transported Away From Industrial Waste Disposal Sites,
W83-03375 5A

Copper(II) Complexing Capacities of Natural Waters by Fluorescence Quenching,
W83-03396 5A

Radioactivity in Water from the River Lea,
W83-03401 5A

Polarographic Determination of Low Levels of Cyanide and Metals in the Waste-Waters Discharged by an Electroplating Plant (Dosages Polarographiques de Faibles Quantities D'Ions Cyanure et de Metaux Dans Les Euax Rejetees Par un Atelier de Galvanoplastie),
W83-03412 5A

Determination of PAH in Water and Sediments by Low Temperature Fluorimetry (Dosage Des Hydrocarbures Aromatiques Polynucleaires Dan Les Eaux Et Les Sediments Par Fluorimetrie A Basse Temperature),
W83-03413 5A

Trace Toxic Metals Determination in Natural Waters Using X-Ray Fluorescence Spectrometry on a Chelating Resin Captor (Determination De Traces Metaux Toxiques Dans Les Eaux Naturelles Par Spectrometrie De Fluorescence X Sur Capteur De Resine Chelatante),
W83-03414 5A

Inverse-Voltammetry of Some Copper Chelates Using a Carbon Paste Electrode. Determination of Copper in Drinking Water by Oxidation of Copper Dithio-Oxamide (Zur Invers-Voltammetrie Einiger Kupferchelate an Der Kohlepaste-Electrode. Bestimmung Von Kupfer in Trinkwasser Durch Oxidation Von Kupferdithiooxamid),
W83-03415 5A

Identification and Quantification of Water Soluble Components of Outboard Motor Exhaust and of Gasoline in a North Dakota Lake,
W83-03428 5A

On the Analysis of Trace Elements Harmful to Humans in River Sediments (Zur Analytik Humangefahrlicher Spurenelemente in Flusssediment),
W83-03442 5A

Identification of the Water Quality Factors Which Prevent Fingernail Clams From Recolonizing the Illinois River, Phase III,
W83-03463 5C

Application of Kelgraph to Electrochemical Detectors for Flow Injection Analysis and High Performance Liquid Chromatography,
W83-03490 5A

POLYETHYLENE IMINES

Use of Polyethylene Imines in Flotation and Improving the Filtration of Suspensions of Blue-Green Algae,
W83-03471 5F

POLYMERS

Composition of Estuarine Colloidal Material: Organic Components,
W83-03202 2L

Water Quality Transmission and Runoff From Easily Crusted Erodable Soils and Mine Spoils. Effects of In-Situ Crosslinkable Oil Treatments,
W83-03269 4D

PONDS

Wastewater Treatment in Rural Areas. There Doesn't Always Have to be a Central Wastewater Treatment Facility (Abwasserreinigung Im Lanlichen Raum. Es Muss Nicht Immer Eine Zentralklaranlage Sein).
W83-03435 5D

POPULATION DENSITY

A Methodology for Algal Population Study of Periphyton: Measurement of Covering Rate (Une Methodologie Pour L Etude Des Populations Algales Du Periphyton: La Mesure Du Taux De Recouvrement),
W83-03407 5A

Species Composition and Distribution of the Macrozoobenthos of the Maritsa River (Vidov Sustav I Razpredelenie Na Makrozoobentosa Ot Reka Maritsa),
W83-03474 5C

POPULATION DYNAMICS

A Methodology for Algal Population Study of Periphyton: Measurement of Covering Rate (Une Methodologie Pour L Etude Des Populations Algales Du Periphyton: La Mesure Du Taux De Recouvrement),
W83-03407 5A

POTABLE WATER

Control of Trihalomethanes in Barcelona's Water Supply (Controle Des Trihalomethanes Dans Les Eaux D'Approvisionnement De Barcelone),
W83-03210 5B

Radon-222 in Potable Water Supplies in Maine: The Geology, Hydrology, Physics and Health Effects,
W83-03308 2K

Causes of Localized Copper Corrosion in Drinking Water Supplies,
W83-03346 5F

POTASSIUM RADIOISOTOPES

Radioactivity in Water from the River Lea,
W83-03401 5A

POTATOES

Obtaining Soil Physical Field Data for Simulating Soil Moisture Regimes and Associated Potato Growth,
W83-03390 2G

POTENTIOMETERS

The Role of Fulvic Substances on Trace Metal Partitioning in Natural Aquatic Sediments,
W83-03348 2K

POWERPLANTS

Effects of Coal Burning in New Mexico on Air Quality and Surface Water Quality: Raton Study Area,
W83-03382 2K

The Use of Industrial Waste Water. I. Aerial and Soil Microclimatic Modifications Due to Heating by Wastewater (20 Degrees C) Circulating in Buried Pipes (Utilisation Des Eaus De Rejet En Agriculture, I. Modifications Microclimatiques Dues Au Chauffage Du Sol Par Tuyaux Enterres, En Plein Champ)
W83-03388 3C

PRECIPITATION

Effects of Increased Precipitation and Grazing Management on Northeastern Montana Rangelands,
W83-03174 4D

Opportunities and Potential Benefits of Radar Rainfall Measurements for the Federal Republic of Germany (Moglichkeiten und Potentieller Nutzen Eines Bundesdeutschen Niederschlagsradar--Verbundsystems),
W83-03240 7B

Comparative Study of the Causes and Effects of Recent Southeastern Droughts,
W83-03297 2B

PRECIPITATION (ATMOSPHERIC)

A Meteorological and Climatological Approach in Determining Snowpack Accumulation at Snow Course Sites in a Montana Watershed,
W83-03465 2A

PREDATION

Biological Role of Perch in the Kremenchug Reservoir,
W83-03472 2H

PRESSURE-MEASURING INSTRUMENTS

A Method for Improving Cheaply the Time Response of Pressure-Transducer Tensiometer Systems,
W83-03409 7B

PRICES

Use of Hedonic Price Technique to Evaluate Wetlands,
W83-03343 6B

PRIMARY PRODUCTION

Agricultural Stream Ecosystems: Structure and Function for Understanding Water Quality Improvements,
W83-03377 6G

PROCESS CONTROL

Topical Questions on Central Control and Monitoring for Water Supplies (Aktuelle Fragen Bei Zentraler Steuerung Und Uberwachung Von Wasserversorgungen),
W83-03449 5F

PRODUCTION FUNCTION

Irrigation Water Response Function Estimation: An Improved Ridge Regression Methodology,
W83-03302 6D

PROJECT PLANNING

Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

PROPERTY VALUES

Use of Hedonic Price Technique to Evaluate Wetlands,
W83-03343 6B

PUBLIC HEALTH

Management of Human Excreta,
W83-03191 5D

Priority Pollutants in Municipal Sewage Sludge, Part II,
W83-03406 5E

Development and Status of Emergency Drinking Water Supply in the Federal Republic of Germany After Passage of the Water Safeguarding Law (Entwicklung und Stand Der Tinkwasser-Notversorgung in Der Bundesrepublik Nach Dem Wassersicherstellungsgesetz),
W83-03458 5F

PUBLIC PARTICIPATION

Multiple Use Reservoir Planning Approaches: Lac Seul, Northwestern Ontario,
W83-03211 6A

Citizen Participation in the Design and Management of Reservoirs,
W83-03418 6A

The Evolution of Public Involvement in Reservoir Developments in Canada,
W83-03421 6G

A Public Participation Decision to Fill a Pacific Northwest Reservoir,
W83-03423 6D

PUERTO RICO
Geohydrology of the Rio Camuy Cave System, Puerto Rico,
W83-03283 2F

A Study of Eutrophication and Aquatic Plants Growths in Selected Lakes and Rivers of Puerto Rico,
W83-03300 5C

An Assessment of the Use Potential of the Flow of Water at the Spring 'Ojo de Agua' in Aguadilla, Puerto Rico,
W83-03321 4B

PULSATORS
How Pulsators and Superpulsators Can Improve the Water Treatment Process,
W83-03220 5F

PUMPED STORAGE
Possibility of Reducing Energy Costs for Water Conveyance Using a Preliminary Reservoir (Einsparmoglichkeit an Energiekosten Zur Wasserforderung Durch Einsatz Eines Vorbehalters),
W83-03459 8A

PUMPS
Returning the Tyne to Life,
W83-03231 5D

Centrifugal Pump Basics,
W83-03258 8C

Wind Energy for Low Head Irrigation,
W83-03309 8C

Energy Reclamation from the Drinking Water System with Series-Connected Pumps (Energierueckgewinnung Aus Dem Trinkwassersystem Mit Serienpumpen),
W83-03460 8C

QUALITY CONTROL
Accuracy of Determination of Total Oxidised Nitrogen and Nitrite in River Waters: Analytical Quality Control in the Harmonised Monitoring Scheme.
W83-03207 5A

QUEBEC
Aquatic Ecology Monitoring Network of the James Bay Power Co. (Le Reseau De Surveillance D'Ecologie Aquatique De La Societe D'Energie De La Baie James),
W83-03394 6G

Backwater Curve Computations Under Ice Covers in the La Grande River (Courbes De Remous Sous Les Couverts De Glace De La Grande Riviere),
W83-03395 2C

RADIATION
Effect of Sunlight on Enumeration of Indicator Bacteria Under Field Conditions,
W83-03291 5A

RADIOACTIVE WASTE DISPOSAL
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-5A, H-5B, and H-5C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03360 2K

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-6A, H-6B, and H-6C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03361 2K

RADIOACTIVE WASTES
Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho--Emphasis: 1974-1978,
W83-03365 5B

Developments, Recommendations and Applications of Tests for Evaluating the Chemical Stability of High-Level Radioactive Solid Waste Forms,
W83-03427 5B

RADIOACTIVITY
Radioactivity in Water from the River Lea,
W83-03401 5A

RADIOISOTOPES
Radioelements, Radiogenic Helium and Age Relationships for Groundwaters From the Granites at Stripa, Sweden,
W83-03208 2F

Extreme Fractionation of U234/U238 and TH230/U234 in Spring Waters, Sediments, and Fossils at the Pomme De Terre Valley, Southwestern Missouri,
W83-03209 2K

Studies of Activation Products in the Terrestrial Environments of Three Swedish Nuclear Power Stations,
W83-03397 5B

RADON-22
Radon-222 in Potable Water Supplies in Maine: The Geology, Hydrology, Physics and Health Effects,
W83-03308 2K

RAINFALL DISTRIBUTION
Obtaining Rainfall Intensity Curves from Munich Rainfall Records (Die Ermittlung Von Regenspendelinien Aus Munchner Regenschreiberaufzeichnungen),
W83-03452 2B

RAINFALL INTENSITY
Rainfall Cell Size From Rit Curve Analysis,
W83-03339 2B

Obtaining Rainfall Intensity Curves from Munich Rainfall Records (Die Ermittlung Von Regenspendelinien Aus Munchner Regenschreiberaufzeichnungen),
W83-03452 2B

Model Rainfall for Sewer System Design Current Knowledge and Recommendations (Modellregren Zur Kanalnetzbemessung - Kenntnisstand Und Empfehlungen),
W83-03453 2A

Improved Formulas for Estimating Groundwater Supplies by Short-Term Precipitation-Minimum Series (Verbesserte Ansatza Fuer Die Schatzung Der Dargebote Von Grundwassermengen Durch Niederschlags-Minimum-Kurzreihen),
W83-03461 2A

RAINFALL INTENSITY-TIME (RIT) CURVES
Rainfall Cell Size From Rit Curve Analysis,
W83-03339 2B

RAINFALL-RUNOFF MODELS
Response Surface Parameter Sensitivity Analysis Methods for Postcalibration Studies,
W83-03293 2A

RAINFALL-RUNOFF RELATIONSHIP
Hydrologic Flow Determination for Hydropower Feasibility Analysis,
W83-03271 2E

RANGE MANAGEMENT
Effects of Increased Precipitation and Grazing Management on Northeastern Montana Rangelands,
W83-03174 4D

RAPID FLOW
Inlet Construction for Vortex Drops With Supercritical Inflow (Einlaufkonstruktion Fur Wirbelfallschachte Mit Schiessendem Zufluss),
W83-03481 8B

RAW WATER
Control of Trihalomethanes in Barcelona's Water Supply (Controle Des Trihalomethanes Dans Les Eaux D'Approvisionnement De Barcelone),
W83-03210 5B

Efficient Utilization of Industrial Waster and Waste Heat for Intensive Fish Production (Die Rationelle Nutzung Von Industriewasser Und Abwarme Fur Eine Intensive Fischproduktion),
W83-03221 3C

RECREATION
Estimation of the Economic Worth of Water for Release Decisions,
W83-03280 6A

RECREATION DEMAND
A Test for Inequity in River Recreation Reservation Systems,
W83-03175 6D

Estimation of the Economic Worth of Water for Release Decisions,
W83-03280 6A

The Costs and Benefits of Soil Erosion Control in the North Lake Chicot Watershed,
W83-03331 4D

RECYCLE
Water Reuse and Recycling in the Textile Industry,
W83-03178 3E

RECYCLING
Identification and Assessment of Effluent Residuals in Treated Leachate from Landfill Disposal Sites,
W83-03272 5E

REGIONAL MODELS
Toward an Econometric Model to Analyze Impacts of Water Availability on the Oregon Economy,
W83-03326 6A

REGRESSION ANALYSIS
The Effects of Altered Hydrologic Regime on Tree Growth Along the Missouri River in North Dakota,
W83-03262 6G

Factors Influencing Hourly and Daily Water Demand (Uber Die Stunden-Und Tagewasserbedarf Beeinflussenden Faktoren),
W83-03438 6D

REMOTE SENSING
Landsat Monitoring of Irrigated Farmland Acreage in Curry County, New Mexico,
W83-03310 7A

RESERVOIR
A Public Participation Decision to Fill a Pacific Northwest Reservoir,
W83-03423 6D

RESERVOIR DESIGN
Computer Simulation of Local Destratification in Reservoirs,
W83-03279 5G

Possibility of Reducing Energy Costs for Water Conveyance Using a Preliminary Reservoir

(Einsparmoglichkeit an Energiekosten Zur Wasserforderung Durch Einsatz Eines Vorbehalters),
W83-03459 8A

RESERVOIR OPERATION
Worth of Inflow Forecast for Reservoir Operation,
W83-03296 4A

Real-Time Forecasting of River Flows and Stochastic Optimal Control of Multireservoir Systems,
W83-03323 4A

RESERVOIR RELEASES
Computer Simulation of Local Destratification in Reservoirs,
W83-03279 5G

Estimation of the Economic Worth of Water for Release Decisions,
W83-03280 6A

RESERVOIR SILTING
Flushing of Reservoirs as a Means of Increasing the Operating Efficiency of Hydroelectric Stations,
W83-03198 8A

Main Results of Investigating Siltation of the Reservoir of the Tereblya-Rika Hyroelectric Station,
W83-03204 2J

RESERVOIRS
Soil Collapses on Shores of Clear Lake Reservoir, Modoc County, California,
W83-03189 8A

Fisheries Productivity and Water Level Fluctuations in Lac Seul, Northwestern Ontario,
W83-03212 6G

Diel Changes in Numbers and Activities of Bacterioplankton in a Reservoir in Relation to Algal Production,
W83-03263 2H

Real-Time Forecasting of River Flows and Stochastic Optimal Control of Multireservoir Systems,
W83-03323 4A

Environmental Problems of Reservoir Development with Special Regard to Conditions in Sweden,
W83-03393 6G

Aquatic Ecology Monitoring Network of the James Bay Power Co. (Le Reseau De Surveillance D'Ecologie Aquatique De La Societe D'Energie De La Baie James),
W83-03394 6G

Sediment Deposition Model for Reservoirs Based on the Dominant Physical Processes,
W83-03417 2J

Citizen Participation in the Design and Management of Reservoirs,
W83-03418 6A

The Development and Effect of Fish Attractors on the Tennessee-Tombigbee Waterway,
W83-03419 6G

Development of a Reservoir Preparation Strategy,
W83-03420 6G

The Evolution of Public Involvement in Reservoir Developments in Canada,
W83-03421 6G

Comparison of Reservoirs with Dissimilar Selective Withdrawal Capabilities: Effects on Reservoir Limnology and Release Water Quality,
W83-03422 5G

Multipurpose Use of an Eutrophic South African Man-Made Reservoir,
W83-03425 6D

Managing for Waves on Nebraska's Lake McConaughy - An Overview,
W83-03426 8A

Possibility of Reducing Energy Costs for Water Conveyance Using a Preliminary Reservoir (Einsparmoglichkeit an Energiekosten Zur Wasserforderung Durch Einsatz Eines Vorbehalters),
W83-03459 8A

RESOURCES DEVELOPMENT
Trans-Boundary Geothermal Resources of Texas and Mexico,
W83-03499 2F

RETENTION
A Method for Calculating the Dimensions of Long Sewage Force Mains,
W83-03199 5D

RETICULATED VITREOUS CARBON ELECTRODE
Determination of the Complexing Capacity of Water Systems by Gel Chromatographic and Electrochemical Techniques,
W83-03185 5A

REUSE
Water Reuse and Recycling in the Textile Industry,
W83-03178 3E

REVERSE OSMOSIS
Parametric Study of Seawater Reverse Osmosis Desalting Plants,
W83-03316 3A

Barrier Effect of Various Methods for Desalinating Seawater in the Presence of Chemical Pollutants (Obezzarazhivayushchii Effekt Razlichnykh Metodov Opresneniya Morskoi Vody V Usloviyakh ee Khimicheskogo Zagryazneniya),
W83-03404 3A

RHODE ISLAND
Recovery and Transport of Heavy Metals by Spartina Alterniflora From Dredging Spoils,
W83-03381 2L

RIDGE REGRESSION METHOD
Irrigation Water Response Function Estimation: An Improved Ridge Regression Methodology,
W83-03302 6D

RIO GRANDE
Water Availability in the New Mexico Upper Rio Grande Basin to the Year 2000,
W83-03493 6D

Anticipating Transboundary Water Needs and Issues in the Mexico-United States Border Region in the Rio Grande Basin,
W83-03495 6D

Surface Water Quality in the Border Area Between El Paso and the Gulf of Mexico,
W83-03500 5G

RISKS
Real-Time Forecasting of River Flows and Stochastic Optimal Control of Multireservoir Systems,
W83-03323 4A

RIVERS
A Test for Inequity in River Recreation Reservation Systems,
W83-03175 6D

Study of the Changes in River Water Quality (Etude De L'Evolution De La Qualite Des Eaux De Riviere),
W83-03267 5B

Backwater Curve Computations Under Ice Covers in the La Grande River (Courbes De Remous Sous Les Couverts De Glace De La Grande Riviere),
W83-03395 2C

On the Analysis of Trace Elements Harmful to Humans in River Sediments (Zur Analytik Humangefahrlicher Spurenelemente in Flusssediment),
W83-03442 5A

Nutrient Contents and Algal Growth in an Impounded River: Effects on Oxygen Balance and need for Nutrient Retention (Nahrstoffgehalte und Algenwachstum in Einem Gestauten Fluss, Auswirkungen Auf Die Sauerstoffbilanz Und Notwendigkeit Des Nahrstoffruckhaltes),
W83-03454 5C

Heavy Metals in Flowing Waters and River Sediments of the Western Harz Region (Schwermetalle in Den Fliessgewassern Und Flusssedimenten Des West-Harzes,
W83-03457 5B

Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

A Modified Sediment Transport Model for Natural Streams,
W83-03494 2J

RURAL AREAS
Wastewater Treatment in Rural Areas. There Doesn't Always Have to be a Central Wastewater Treatment Facility (Abwasserreinigung Im Lanlichen Raum. Es Muss Nicht Immer Eine Zentralklaranlage Sein).
W83-03435 5D

SAGO PONDWEED
Threshold 2,4-D Concentrations for Control of Eurasian Watermilfoil and Sago Pondweed,
W83-03163 4A

SALINE LAKES
Zoobenthos of Lakes of Black Sea Reservation (Preserve),
W83-03479 2H

SALINITY
A Seasonal Study of the Distributions of Surface State Variables in Liverpool Bay. III. An Offshore Front,
W83-03173 2L

A Computer Model for Predicting the Impact of Irrigating with Saline Water on Soils and Runoff Water in Missouri,
W83-03284 3C

Recovery and Transport of Heavy Metals by Spartina Alterniflora From Dredging Spoils,
W83-03381 2L

Problems of Irrigated Agriculture in Al-Hassa, Saudi Arabia,
W83-03391 3C

SALMONELLA
The Removal of Salmonella Enteritidis in Activated Sludge,
W83-03152 5D

Improved Salmonella Recovery from Moderate to Highly Polluted Waters,
W83-03164 5A

SAMPLE PREPARATION
The Influence of Sample Treatment on Nutrient Analysis in Eutrophic Waters (Der Einfluss Der Probenbehandlung Auf Die Nahrstoffanalytik Bei Eutrophen Gewassern),
W83-03392 5A

SAMPLE PRESERVATION
Effect of Sunlight on Enumeration of Indicator Bacteria Under Field Conditions,
W83-03291 5A

The Influence of Sample Treatment on Nutrient Analysis in Eutrophic Waters (Der Einfluss Der Probenbehandlung Auf Die Nahrstoffanalytik Bei Eutrophen Gewassern),
W83-03392 5A

SAMPLING
Sampling Macrofauna in Ditches,
W83-03217 7B

Cost and Precision in a Stream Sampling Program,
W83-03336 6C

SANITARY LANDFILLS
Chemical Effects of Selected Trace-Metals From Sanitary Landfill Leachates on Groundwater Quality,
W83-03340 5E

SAPROPHYTIC BACTERIA
Tendencies in the Changes in the Saprobic Conditions of the Maritsa River (Tendentsii V Izmenenyata Na Saprobiolodgichnoto Sustoyanie Na Reka Maritsa),
W83-03473 5C

The Species Deficit of the Macrozoobenthic Communities as a Criterion for the Transsaprobic Influences on the Maritsa River (Vidoviyat Defitsit Na Makrozoobentosnite Suobshchestva Kato Kriterii Za Transsaprobnite Vliyaniya Vurkhu Reka Maritsa),
W83-03475 5C

SAUDI ARABIA
Problems of Irrigated Agriculture in Al-Hassa, Saudi Arabia,
W83-03391 3C

SCOTLAND
The Megget Scheme.
W83-03248 8A

An Evaluation of Proposed Cage Fish Culture on Loch Lomond, An Important Reservoir in Central Scotland,
W83-03403 6G

SEASONAL VARIATION
The Influence of Micro-Algae on the Oxygen Dynamics in a Brackish Ditch,
W83-03215 5C

Meromixis in an Equatorial African Soda Lake,
W83-03254 2H

Diel Changes in Numbers and Activities of Bacterioplankton in a Reservoir in Relation to Algal Production,
W83-03263 2H

SEAWATER
Final Results of Testing of Abcor 8 Inches Spiral Wound Ultra-Filters at The Wrightsville Beach Test Facility,
W83-03288 3A

Parametric Study of Seawater Reverse Osmosis Desalting Plants,
W83-03316 3A

SECCHI DEPTH
A Survey of Water Transparency in Iowa Lakes,
W83-03371 5C

SECONDARY PRODUCTIVITY
Production of Invertebrates in the Tidewater Zone of a Coastal River and Adjacent Estuary,
W83-03183 2L

SEDIMENT CONTROL
Flushing of Reservoirs as a Means of Increasing the Operating Efficiency of Hydroelectric Stations,
W83-03198 8A

SEDIMENT DISCHARGE
Dynamic Modelling of Suspended Sediment Transport in Streams as a Function of Sediment Supply,
W83-03368 2J

SEDIMENT LOAD
Dynamic Modelling of Suspended Sediment Transport in Streams as a Function of Sediment Supply,
W83-03368 2J

SEDIMENT TRANSPORT
Main Results of Investigating Siltation of the Reservoir of the Tereblya-Rika Hyroelectric Station,
W83-03204 2J

Evaluation and Monitoring of the Hydrologic Impact of Cabin Creek, B.C. Coal Pit Mining on the North Fork of the Flathead River,
W83-03325 6G

Dynamic Modelling of Suspended Sediment Transport in Streams as a Function of Sediment Supply,
W83-03368 2J

A Modified Sediment Transport Model for Natural Streams,
W83-03494 2J

SEDIMENT YIELD
Evaluation and Monitoring of the Hydrologic Impact of Cabin Creek, B.C. Coal Pit Mining on the North Fork of the Flathead River,
W83-03325 6G

SEDIMENTATION
Sedimentologic Study of the Mouth of the Gabon River Estuary (Etude Sedimentologique De L'Embouchure De L'Estuaire Du Gabon),
W83-03257 2L

Soil Conservation and the Reduction of Erosion and Sedimentation in the Coon Creek Basin, Wisconsin,
W83-03356 4D

Sediment Deposition Model for Reservoirs Based on the Dominant Physical Processes,
W83-03417 2J

Anaerobic Activated Sludge Treatment of Filtrates From Thermally Conditioned Sludges (Die Behandling Von Filtratwassern Thermisch Konditionierter Schlamme Nach Anaeroben Belebunsverfahren),
W83-03440 5D

SEDIMENTATION RATES
A Stochastic Model for Suspended Solids Settling Velocity,
W83-03158 2J

Post-Mining Neutralization of Acidic Surface Mine Lakes,
W83-03278 5B

SEDIMENTS
Evaluating the Release of Soluble Components from Sediment,
W83-03168 5B

Extreme Fractionation of U234/U238 and TH230/U234 in Spring Waters, Sediments, and Fossils at the Pomme De Terre Valley, Southwestern Missouri,
W83-03209 2K

Determination of PAH in Water and Sediments by Low Temperature Fluorimetry (Dosage Des Hydrocarbures Aromatiques Polynucleaires Dan Les Eaux Et Les Sediments Par Fluorimetrie A Basse Temperature),
W83-03413 5A

On the Analysis of Trace Elements Harmful to Humans in River Sediments (Zur Analytik Humangefahrlicher Spurenelemente in Flusssediment),
W83-03442 5A

Pyrite and Oxidized Iron Mineral Phases Formed from Pyrite Oxidation in Salt Marsh and Estuarine Sediments,
W83-03451 2L

Heavy Metals in Flowing Waters and River Sediments of the Western Harz Region (Schwermetalle in Den Fliessgewassern Und Flusssedimenten Des West-Harzes,
W83-03457 5B

SEEPAGE
Saline Seepage and Vertical Distribution of Oxygen in a Brackish Ditch,
W83-03216 5C

Evaluating the Reliability of Earth Dams According to the Second Group of Limit States (Method of Predicting Dam Behavior),
W83-03218 8D

Basin-Scale Evapotranspiration Determination through Watershed and Climate Analyses,
W83-03328 2D

SEEPAGE METERS
Use of Seepage Meters and Mini-Piezometers for Identification of Reservoir - Groundwater Interactions in Lake Mead, Nevada,
W83-03487 7B

SELECTIVE FEEDING
Control of Algal Dominance Through Changes in Zooplankton Grazing, Lake Washington: Phase I,
W83-03467 5G

SELENIUM
Selenium in Reducing Waters,
W83-03266 5B

SENSITIVITY ANALYSIS
Response Surface Parameter Sensitivity Analysis Methods for Postcalibration Studies,
W83-03293 2A

SEPARATION TECHNIQUES
The Removal of Salmonella Enteritidis in Activated Sludge,
W83-03152 5D

Improved Salmonella Recovery from Moderate to Highly Polluted Waters,
W83-03164 5A

Methodologies for Extraction of Dissolved Inorganic Carbon for Stable Carbon Isotope Studies: Evaluation and Alternatives,
W83-03359 2K

SEPTIC TANKS
The Movement of Nitrates, Phosphates, and Fecal Coliform Bacteria From Disposal Systems Installed in Selected Connecticut Soils,
W83-03276 5B

SETTLING TANKS
New Design Guidelines for Vertical-Current Final Settling Tanks for Activated Sludge Plants (Neue Bemessungs-Grundlagen Fur Vertikal Durchstromite Nachklarkecken Von Belebungsanlagen),
W83-03437 5D

SETTLING VELOCITY
A Stochastic Model for Suspended Solids Settling Velocity,
W83-03158 2J

SEWER SYSTEMS
Water and Sewer System Modelling Using a Micro-Computer System,
W83-03243 5F

Hydraulic Analysis of Surcharged Storm Sewer Systems,
W83-03374 8B

Obtaining Rainfall Intensity Curves from Munich Rainfall Records (Die Ermittlung Von Regenspendelinien Aus Munchner Regenschreiberaufzeichnungen),
W83-03452 2B

Automation in Wastewater Technology and Water Quality. Practical Experience with Control, Regulation, and Automation in Sewer Systems, Wastewater Treatment, and Water Quality Control (Automation in Der Abwassertechnik und Gewassergute. Praktische Erfahrungen Bei Der Steuerung, Regelung und Automation Bei Der Abwasserableitung, Abwasserbehandlung und Gewasserguteuberwachung,
W83-03469 5D

SHELLFISH
Lead and Other Trace Metals in the Sediments and Selected Biota of Princess Royal Harbour, Albany, Western Australia,
W83-03399 5B

SHELTERBELTS
Wind Energy for Low Head Irrigation,
W83-03309 8C

SILTING
Main Results of Investigating Siltation of the Reservoir of the Tereblya-Rika Hyroelectric Station,
W83-03204 2J

SLUDGE
Priority Pollutants in Municipal Sewage Sludge, Part II,
W83-03406 5E

SLUDGE CONDITIONING
Tree of Knowledge.
W83-03234 5D

SLUDGE DRYING
Effect of Precipitation Purification on the Behavior of Sludges During Mechanical Dewatering (Einfluss Der Fallungsreinigung Auf Das Verhalten Von Klarschlammen Bei Der Mechanischen Entwasserung),
W83-03444 5D

SLUDGE THICKENING
Mother Nature as Sludge Thickener,
W83-03227 5F

Effect of Precipitation Purification on the Behavior of Sludges During Mechanical Dewatering (Einfluss Der Fallungsreinigung Auf Das Verhalten Von Klarschlammen Bei Der Mechanischen Entwasserung),
W83-03444 5D

SLUDGES
Identification and Assessment of Effluent Residuals in Treated Leachate from Landfill Disposal Sites,
W83-03272 5E

SNOWFALL
A Meteorological and Climatological Approach in Determining Snowpack Accumulation at Snow Course Sites in a Montana Watershed,
W83-03465 2A

SNOWMELT
An Economic Analysis of the Devils Lake Basin and Proposed Land Use,
W83-03270 6B

SNOWPACK
A Meteorological and Climatological Approach in Determining Snowpack Accumulation at Snow Course Sites in a Montana Watershed,
W83-03465 2A

SODIUM CHLORIDE
Chemostat Adaptation of Escherichia Coli B/r/1 to Low Water Activity,
W83-03151 5D

SOIL CHEMICAL PROPERTIES
The Role of Fulvic Substances on Trace Metal Partitioning in Natural Aquatic Sediments,
W83-03348 2K

SOIL CONSERVATION
Soil Conservation and Water Quality Improvement: What Farmers Think,
W83-03161 4D

Conservation of Soil, Water, andd Energy Through Reduced Tillage Systems - Phase I sub 1,
W83-03287 4D

The Costs and Benefits of Soil Erosion Control in the North Lake Chicot Watershed,
W83-03331 4D

SOIL CONTAMINATION
Organics Transported Through Selected Geologic Media: Assessment of Organics Transported Away From Industrial Waste Disposal Sites,
W83-03375 5A

SOIL DENSITY PROBES
On The Esimation of the Error of Soil Moisture Measurement by Means of a Neutron Scattering Probe (Zur Abschatzung Des Fehlers Der Bodenfeuchte-Messung Mit Einer Neutronensonde),
W83-03242 7B

SOIL DISPOSAL FIELDS
The Movement of Nitrates, Phosphates, and Fecal Coliform Bacteria From Disposal Systems Installed in Selected Connecticut Soils,
W83-03276 5B

SOIL EROSION
Conservation of Soil, Water, andd Energy Through Reduced Tillage Systems - Phase I sub 1,
W83-03287 4D

Effects of Silvicultural Practices on Water Quality in Northern Wisconsin,
W83-03304 5G

The Costs and Benefits of Soil Erosion Control in the North Lake Chicot Watershed,
W83-03331 4D

Soil Conservation and the Reduction of Erosion and Sedimentation in the Coon Creek Basin, Wisconsin,
W83-03356 4D

SOIL MOISTURE
Efficient Use of Water for Irrigation in the Upper Midwest,
W83-03282 6D

Obtaining Soil Physical Field Data for Simulating Soil Moisture Regimes and Associated Potato Growth,
W83-03390 2G

SOIL MOISTURE METERS
On The Esimation of the Error of Soil Moisture Measurement by Means of a Neutron Scattering Probe (Zur Abschatzung Des Fehlers Der Bodenfeuchte-Messung Mit Einer Neutronensonde),
W83-03242 7B

SOIL MOISTURE MODELS
Efficient Use of Water for Irrigation in the Upper Midwest,
W83-03282 6D

SOIL PROPERTIES
Obtaining Soil Physical Field Data for Simulating Soil Moisture Regimes and Associated Potato Growth,
W83-03390 2G

SOIL STABILITY
Determination of the Parameters of Large Unlined Canals on the Basis of Hydrologicomorphological Analogy,
W83-03197 8D

SOIL STABILIZATION
Water Quality Transmission and Runoff From Easily Crusted Erodable Soils and Mine Spoils. Effects of In-Situ Crosslinkable Oil Treatments,
W83-03269 4D

SOIL TEMPERATURE
The Use of Industrial Waste Water. I. Aerial and Soil Microclimatic Modifications Due to Heating by Wastewater (20 Degrees C) Circulating in Buried Pipes (Utilisation Des Eaus De Rejet En Agriculture, I. Modifications Microclimatiques Dues Au Chauffage Du Sol Par Tuyaux Enterres, En Plein Champ)
W83-03388 3C

SOIL TREATMENT
Water Quality Transmission and Runoff From Easily Crusted Erodable Soils and Mine Spoils. Effects of In-Situ Crosslinkable Oil Treatments,
W83-03269 4D

SOIL WATER
On The Esimation of the Error of Soil Moisture Measurement by Means of a Neutron Scattering Probe (Zur Abschatzung Des Fehlers Der Bodenfeuchte-Messung Mit Einer Neutronensonde),
W83-03242 7B

SOIL WATER MOVEMENT
A Computer Model for Predicting the Impact of Irrigating with Saline Water on Soils and Runoff Water in Missouri,
W83-03284 3C

SOIL WATER POTENTIAL
Undisturbed Core Method for Determining and Evaluating the Hydraulic Conductivity of Unsaturated Sediments,
W83-03319 2G

SOLAR RADIATION
Photoinduced Hydroxylation Reactions of Organic Chemicals in Natural Waters, Nitrates as Potential OH Radical Sources (Photoinduzierte Hydroxylierungsreaktionen Organischer Chemikalien in Naturlichen Gewassern, Nitrate Als Potentielle Oh-Radikalquellen),
W83-03385 5B

SOLUTE TRANSPORT
The Extent and Nature of Rainfall-Soil Interaction in the Release of Soluble Chemicals to Runoff,
W83-03170 5B

SORGHUM
A Method for Applying Crop Sensitivity Factors in Irrigation Scheduling,
W83-03384 3F

SOUTH AFRICA
Current Stormwater Drainage Practice in South Africa,
W83-03387 4A

Multipurpose Use of an Eutrophic South African Man-Made Reservoir,
W83-03425 6D

SOUTH CAROLINA
Investigation Into Effective Control Methods for Brazilian Elodea (Egeria Densa Planchon) in Lake Marion, S.C.,
W83-03433 4A

Ground Water Quantity and Quality in Fracture Zones in Abbeville County, South Carolina,
W83-03466 3B

SOUTH DAKOTA
Efficiency of Water Use by Crops Under Allelopathy Stress,
W83-03313 2I

Tillage and Irrigation Management Practices for Optimum Crop Production,
W83-03329 3F

SOYBEAN RESIDUE
Effect of Incorporation of Fall-Applied Fertilizer on Runoff Losses of Nutrients and Soil From Soybean Ground,
W83-03298 2J

SOYBEANS
Efficiency of Water Use by Crops Under Allelopathy Stress,
W83-03313 2I

SPAIN
Control of Trihalomethanes in Barcelona's Water Supply (Controle Des Trihalomethanes Dans Les Eaux D'Approvisionnement De Barcelone),
W83-03210 5B

SPARTINA
Recovery and Transport of Heavy Metals by Spartina Alterniflora From Dredging Spoils,
W83-03381 2L

SPATFALL
The Effect of Aufwuchs Copper on Spat Settlement of the Oyster, Crassostrea Virginica,
W83-03429 5C

SPECIATION
The Chemistry of Geothermal Waters in Iceland. I. Calculation of Aqueous Specification from 0 to 370C,
W83-03201 2K

Selenium in Reducing Waters,
W83-03266 5B

SPOIL DISPOSAL
Assessing Enviromental Impacts of Open Water Disposal of Dredged Sediment,
W83-03251 6G

SPRING WATER
Extreme Fractionation of U234/U238 and TH230/U234 in Spring Waters, Sediments, and Fossils at the Pomme De Terre Valley, Southwestern Missouri,
W83-03209 2K

SPRINGS
An Assessment of the Use Potential of the Flow of Water at the Spring 'Ojo de Agua' in Aguadilla, Puerto Rico,
W83-03321 4B

The Biota of Oklahoma Springs: Natural Biological Monitoring of Groundwater Quality,
W83-03347 2H

Problems of Irrigated Agriculture in Al-Hassa, Saudi Arabia,
W83-03391 3C

SPRINKLER IRRIGATION
Tillage and Irrigation Management Practices for Optimum Crop Production,
W83-03329 3F

STABILITY ANALYSIS
Meromixis in an Equatorial African Soda Lake,
W83-03254 2H

STABLE ISOTOPES
Methodologies for Extraction of Dissolved Inorganic Carbon for Stable Carbon Isotope Studies: Evaluation and Alternatives,
W83-03359 2K

Environmental Isotopic and Hydrogeochemical Investigation of Recharge and Subsurface Flow in Eagle Valley, Nevada,
W83-03380 2F

STANDARDS
The Meaning of the Generally Accepted Technological Standards for the Planning, Construction, and Operation of Water Distribution Facilities (Die Bedeutung Der Anerkannten Regeln Der Technik Fur Planung, Bau und Betrieb Von Wasserversorgungsanlagen),
W83-03441 6E

STARCH BENTHIC FLORA
Investigation Into Effective Control Methods for Brazilian Elodea (Egeria Densa Planchon) in Lake Marion, S.C.,
W83-03433 4A

STATE JURISDICTION
The Evolution of California State Water Planning 1850-1928,
W83-03274 6E

Overview of Groundwater Law and Institutions in United States Border States,
W83-03496 6E

STATISTICAL ANALYSIS
Study of the Changes in River Water Quality (Etude De L'Evolution De La Qualite Des Eaux De Riviere),
W83-03267 5B

Obtaining Rainfall Intensity Curves from Munich Rainfall Records (Die Ermittlung Von Regenspendelinien Aus Munchner Regenschreiberaufzeichnungen),
W83-03452 2B

Model Rainfall for Sewer System Design Current Knowledge and Recommendations (Modellregren Zur Kanalnetzbemessung - Kenntnisstand Und Empfehlungen),
W83-03453 2A

Improved Formulas for Estimating Groundwater Supplies by Short-Term Precipitation-Minimum Series (Verbesserte Ansatza Fuer Die Schatzung Der Dargebote Von Grundwassermengen Durch Niederschlags-Minimum-Kurzreihen),
W83-03461 2A

STATISTICAL MODELS
Model Rainfall for Sewer System Design Current Knowledge and Recommendations (Modellregren Zur Kanalnetzbemessung - Kenntnisstand Und Empfehlungen),
W83-03453 2A

A Meteorological and Climatological Approach in Determining Snowpack Accumulation at Snow Course Sites in a Montana Watershed,
W83-03465 2A

STEP-BACKWATER COMPUTATIONS
Verification of Step-Backwater Computations on Ephemeral Streams in Northeastern Wyoming,
W83-03366 2E

STOCHASTIC HYDROLOGY
Regional Detection of Change in Water Quality Variables,
W83-03295 2A

STOCHASTIC PROCESS
A Stochastic Model for Suspended Solids Settling Velocity,
W83-03158 2J

STORM RUNOFF
Water Quality of Airport Storm Runoff,
W83-03353 5B

STORM SEWERS
Hydraulic Analysis of Surcharged Storm Sewer Systems,
W83-03374 8B

STORM WASTEWATER
Influence of Land Utilization on Hydrocarbon Runoff Pollution,
W83-03156 5B

STORMS
Managing for Waves on Nebraska's Lake McConaughy - An Overview,
W83-03426 8A

STORMWATER
Current Stormwater Drainage Practice in South Africa,
W83-03387 4A

STRAIN GAGES
Automated Strain Gage Dendrography for Improved Water Utilization in Plants,
W83-03372 2I

STRAITS
Water Mixing in a Tidal Current and the Effect of Turbulence on Tidal Exchange Through a Strait,
W83-03159 2L

STRATIFICATION
Computer Simulation of Local Destratification in Reservoirs,
W83-03279 5G

STREAM POLLUTION
Effects of Sewage Pollution in the White River, Arkansas on Benthos and Leaf Detritus Decomposition,
W83-03332 5C

STREAMFLOW
Verification of Step-Backwater Computations on Ephemeral Streams in Northeastern Wyoming,
W83-03366 2E

STREAMFLOW FORECASTING
Worth of Inflow Forecast for Reservoir Operation,
W83-03296 4A

STREAMFLOWS
Comparative Study of the Causes and Effects of Recent Southeastern Droughts,
W83-03297 2B

STRIP MINE LAKES
Post-Mining Neutralization of Acidic Surface Mine Lakes,
W83-03278 5B

STRIP MINES
Deuterium as a Tracer in the Groundwater Study of a Central North Dakota Mining Area,
W83-03177 5A

Hydrology of Area 14, Eastern Coal Province, Kentucky,
W83-03355 7C

SUGAR-BEET
Effect of Irrigation and Harvesting Dates on the Yield of Spring-Sown Sugar-Beet,
W83-03383 3F

SULFATES
Removal of Nitrate, Sulfate and Hardness from Groundwater by Ion Exchange,
W83-03290 5F

SURFACE DRAINAGE
Influence of Agricultural Drainage on Water Quality,
W83-03289 5B

SURFACE-GROUNDWATER RELATIONS
Use of Seepage Meters and Mini-Piezometers for Identification of Reservoir - Groundwater Interactions in Lake Mead, Nevada,
W83-03487 7B

SURFACE RUNOFF
Water Storage Capacity of Natural Wetland Depressions in the Devils Lake Basin of North Dakota,
W83-03160 2H

Modified Monthly Minimum Method for Rapid Calculation of Groundwater Recharge from Receiving Stream Runoff (Das Modifizierte Verfahren MoMNO (r12) Zur Raschen Ermittlung Der Grundwasserneubildungsrate Aus Dem Vorfluterabfluss),
W83-03447 2F

SURFACE WATER
Hydrology of Area 14, Eastern Coal Province, Kentucky,
W83-03355 7C

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigtion. Part 3: Canadian, North Canadian, and Deep Fork River Basins through 1979,
W83-03362 7C

Use of Water in Arkansas, 1980,
W83-03367 6D

Effects of Coal Burning in New Mexico on Air Quality and Surface Water Quality: Raton Study Area,
W83-03382 2K

SURFACTANTS
The Role of Cationic Surfactants in the Renovation of Water,
W83-03275 5F

SURVEY
The Concord Water Survey,
W83-03351 3D

SURVEYS
An Economic Analysis of the Devils Lake Basin and Proposed Land Use,
W83-03270 6B

SUSPENDED LOAD
Dynamic Modelling of Suspended Sediment Transport in Streams as a Function of Sediment Supply,
W83-03368 2J

SUSPENDED SEDIMENTS
Particulate Matter Resuspension Via Metabolically Produced Gas Bubbles From Benthic Estuarine Microalgae Communities,
W83-03261 2L

An Evaluation of Sediments in the Middle Rio Grande, Elephant Butte Reservoir, and Caballo Reservoir as Potential Sources for Toxic Meterials,
W83-03322 5B

Dynamic Modelling of Suspended Sediment Transport in Streams as a Function of Sediment Supply,
W83-03368 2J

SUSPENDED SOLIDS
A Stochastic Model for Suspended Solids Settling Velocity,
W83-03158 2J

Trace Elements (Manganese, Zinc and Copper) in the USSR Part of the Danube River,
W83-03470 5B

A Modified Sediment Transport Model for Natural Streams,
W83-03494 2J

SWEDEN
Radioelements, Radiogenic Helium and Age Relationships for Groundwaters From the Granites at Stripa, Sweden,
W83-03208 2F

Environmental Problems of Reservoir Development with Special Regard to Conditions in Sweden,
W83-03393 6G

Studies of Activation Products in the Terrestrial Environments of Three Swedish Nuclear Power Stations,
W83-03397 5B

SWITZERLAND
The Zurich Water Supply System,
W83-03229 5F

SYSTEMS ANALYSIS
Mathematical Model for Long-Term Water Supply Planning (Mathematisches Modell Fur Die Langfristige Wasserversorgungsplanung),
W83-03224 6A

TANKS
Plastic Tanks: Pitfalls to Avoid,
W83-03250 8G

TASTE
Causes of Localized Copper Corrosion in Drinking Water Supplies,
W83-03346 5F

TECHNOLOGY
Problems of the Load at Veb Zellstoff-Und Papierfabrik Rosenthal (Probleme Der Abwasserlast Im Veb Zellstoff-Und Papierfabrik Rosenthal),
W83-03223 5D

TECHNOLOGY ASSESSMENT
Technology Assessment of Irrigation Scheduling and Crop Response,
W83-03488 3F

TECHNOLOGY TRANSFER
Agricultural Irrigation Technology Transfer Assessment,
W83-03281 3F

A Center for the Transfer of Desalination Technology,
W83-03352 3A

TECHNOLOGY TRANSFER PRODUCTS
Agricultural Irrigation Technology Transfer Assessment,
W83-03281 3F

TENNESSEE RIVER
Biodegradation of 1,3-Dinitrobenzene,
W83-03155 5B

TENNESSEE-TOMBIGBEE WATERWAY
The Development and Effect of Fish Attractors on the Tennessee-Tombigbee Waterway,
W83-03419 6G

TENSIOMETERS
A Method for Improving Cheaply the Time Response of Pressure-Transducer Tensiometer Systems,
W83-03409 7B

TERTIARY WASTEWATER TREATMENT
Reuse of Treated Municipal Wastewater in the Technical Supply of Industrial Companies in Moscow (Die Wiederverwendung Des Gereinigten Kommunalen Abwasser In Der Technischen Wasserversorgung Der Moskauer Industriebetriebe),
W83-03222 5D

TESTING PROCEDURES
Lagoon Algae and the BOD Test,
W83-03400 5A

TEXAS
Assessment of Stormflow and Water Quality From Undisturbed and Site Prepared Forest Land in East Texas,
W83-03277 4C

Anticipating Transboundary Water Needs and Issues in the Mexico-United States Border Region in the Rio Grande Basin,
W83-03495 6D

Texas Groundwater Law: A Survey and Some Proposals,
W83-03497 6E

Trans-Boundary Geothermal Resources of Texas and Mexico,
W83-03499 2F

Surface Water Quality in the Border Area Between El Paso and the Gulf of Mexico,
W83-03500 5G

TEXTILE INDUSTRIES
Water Reuse and Recycling in the Textile Industry,
W83-03178 3E

THE NETHERLANDS
Obtaining Soil Physical Field Data for Simulating Soil Moisture Regimes and Associated Potato Growth,
W83-03390 2G

THERMAL RADIATION
Experimental and Analytical Study of Heat Transfer and Mixing in Thermally Stratified Buoyant Flows,
W83-03370 2H

THERMAL SPRINGS
The Chemistry of Geothermal Waters in Iceland. I. Calculation of Aqueous Specification from 0 to 370C,
W83-03201 2K

THERMAL STRATIFICATION
Experimental and Analytical Study of Heat Transfer and Mixing in Thermally Stratified Buoyant Flows,
W83-03370 2H

THERMAL WATER
Hygienic Evaluation of Hydrogen Sulfide-Containing Thermal Waters Used in Hot Water Supply Systems (Gigiena Otsenka Serovodnykh Termal'Nykh Vod, Ispol'Zuemykh V Sisteme Goryachego Vodosnabzheniya),
W83-03405 5C

THUNDERSTORMS
Johnstown-Western Pennsylvania Storm and Floods of July 19-20, 1977,
W83-03357 2E

TIDAL CURRENTS
Water Mixing in a Tidal Current and the Effect of Turbulence on Tidal Exchange Through a Strait,
W83-03159 2L

Sedimentologic Study of the Mouth of the Gabon River Estuary (Etude Sedimentologique De L'Embouchure De L'Estuaire Du Gabon),
W83-03257 2L

TIDAL EFFECTS
Water Mixing in a Tidal Current and the Effect of Turbulence on Tidal Exchange Through a Strait,
W83-03159 2L

Chesapeake Bay Nutrient and Plankton Dynamics. 1. Bacterial Biomass and Production During Spring Tidal Destratification in the York River, Virginia, Estuary,
W83-03264 2L

TIDAL MARSHES
Recovery and Transport of Heavy Metals by Spartina Alterniflora From Dredging Spoils,
W83-03381 2L

TILLAGE SYSTEMS
Conservation of Soil, Water, andd Energy Through Reduced Tillage Systems - Phase I sub 1,
W83-03287 4D

TIME SERIES ANALYSIS
Estimation of the Economic Worth of Water for Release Decisions,
W83-03280 6A

TITRATION
Copper(II) Complexing Capacities of Natural Waters by Fluorescence Quenching,
W83-03396 5A

TOTAL COSTS
Costs of Phosphate Elimination in Municipal Wastewater Facilities (Kosten Der Phosphatelimination in Kommunalen Klaranlagen),
W83-03436 5D

TOXICITY
Effects of Simulated Acid Rain on Yields of Raphanus Sativus, Lactuca Sativa, Triticum Aestivum and Medicago Sativa,
W83-03195 5C

Identification and Assessment of Effluent Residuals in Treated Leachate from Landfill Disposal Sites,
W83-03272 5E

Hygienic Evaluation of Hydrogen Sulfide-Containing Thermal Waters Used in Hot Water Supply Systems (Gigiena Otsenka Serovodnykh Termal'Nykh Vod, Ispol'Zuemykh V Sisteme Goryachego Vodosnabzheniya),
W83-03405 5C

TOXICITY TESTS
Development of a Cell Culture Screen for Water Toxicity,
W83-03306 5A

TRACE ELEMENTS
Macro and Trace-Elements in Drinking Water and Foods. Part 2 (Macro Ed Oligoelementi Nell'Apporto Idrico Ed Alimentare. Nota 2),
W83-03483 5B

TRACE METALS
Chemical Effects of Selected Trace-Metals From Sanitary Landfill Leachates on Groundwater Quality,
W83-03340 5E

On the Analysis of Trace Elements Harmful to Humans in River Sediments (Zur Analytik Humangefahrlicher Spurenelemente in Flusssediment),
W83-03442 5A

Trace Elements (Manganese, Zinc and Copper) in the USSR Part of the Danube River,
W83-03470 5B

TRACERS
Applications of a Serratia Marcescens Bacteriophage as a New Microbial Tracer of Aqueous Environments,
W83-03165 5B

TRAINING
A Center for the Transfer of Desalination Technology,
W83-03352 3A

TRANSPIRATION
Measurement of Actual Transpiration of Native Grass Stands as a Component of Nebraska Sandhills Groundwater Hydrology,
W83-03312 2D

Automated Strain Gage Dendrography for Improved Water Utilization in Plants,
W83-03372 2I

TRAVEL TIME
Estimation of the Economic Worth of Water for Release Decisions,
W83-03280 6A

TREES
Forests, Wetlands and Waterfowl Populations in the Turtle Mountains of North Dakota and Manitoba,
W83-03181 2L

The Effects of Altered Hydrologic Regime on Tree Growth Along the Missouri River in North Dakota,
W83-03262 6G

Production and Decomposition of Forest Litter Fall on the Apalachicola River Flood Plain, Florida,
W83-03364 5B

TRIHALOMETHANES
Molecular Size Determination of Chloroform Precursors,
W83-03187 5A

Control of Trihalomethanes in Barcelona's Water Supply (Controle Des Trihalomethanes Dans Les Eaux D'Approvisionnement De Barcelone),
W83-03210 5B

Prechlorination and Trihalomethane Formation at Water Treatment,
W83-03228 5F

TRITIUM
Environmental Isotopic and Hydrogeochemical Investigation of Recharge and Subsurface Flow in Eagle Valley, Nevada,
W83-03380 2F

TUFA
Tufa Precipitation and its Effect on Drainage of Interstate Highways in Northeastern Ohio,
W83-03213 5B

TURBIDITY
Optimization and Dynamic Control of the Coagulation Process in Water Treatment,
W83-03373 5F

TURBINES
Energy Reclamation from the Drinking Water System with Series-Connected Pumps (Energierueckgewinnung Aus Dem Trinkwassersystem Mit Serienpumpen),
W83-03460 8C

TURBULENT FLOW
Water Mixing in a Tidal Current and the Effect of Turbulence on Tidal Exchange Through a Strait,
W83-03159 2L

ULTRAFILTRATION
Final Results of Testing of Abcor 8 Inches Spiral Wound Ultra-Filters at The Wrightsville Beach Test Facility,
W83-03288 3A

ULTRAVIOLET RADIATION
UV-Ozone Process for the Concurrent Decomposition of Halogenated Alkanes and the Disinfection of Water,
W83-03338 5F

UNDERGROUND RIVERS
Geohydrology of the Rio Camuy Cave System, Puerto Rico,
W83-03283 2F

UNDERGROUND STREAMS
Geohydrology of the Rio Camuy Cave System, Puerto Rico,
W83-03283 2F

UNDERGROUND WASTE DISPOSAL
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-5A, H-5B, and H-5C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03360 2K

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-6A, H-6B, and H-6C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03361 2K

UNITED KINGDOM
A 'Before and After' Study of the Effects of Land Drainage Works on Fish Stocks in the Upper Reaches of a Lowland River,
W83-03192 6G

Returning the Tyne to Life,
W83-03231 5D

Slide Valves Save Costs.
W83-03232 8C

Water Industry Accountability Through the Ombudsman System,
W83-03233 6E

Tree of Knowledge.
W83-03234 5D

Fit to Drink,
W83-03236 5F

Fish Farm Effluents--Cause for Concern,
W83-03237 5B

Winter of Frosts, Floods and Bursts.
W83-03244 5F

Valves, Penstocks and Actuators: Reliable Control of Water Systems,
W83-03245 5F

Water Supply for the Lizard.
W83-03246 5F

Radioactivity in Water from the River Lea,
W83-03401 5A

UNITED STATES
Water-Its Role From Now to the Year 2000,
W83-03491 6D

UNSATURATED HYDRAULIC CONDUCTIVITY
Undisturbed Core Method for Determining and Evaluating the Hydraulic Conductivity of Unsaturated Sediments,
W83-03319 2G

UNSTEADY FLOW
Hydraulic Analysis of Surcharged Storm Sewer Systems,
W83-03374 8B

URANIUM RADIOISOTOPES
Radioelements, Radiogenic Helium and Age Relationships for Groundwaters From the Granites at Stripa, Sweden,
W83-03208 2F

Extreme Fractionation of U234/U238 and TH230/U234 in Spring Waters, Sediments, and Fossils at the Pomme De Terre Valley, Southwestern Missouri,
W83-03209 2K

URBAN RUNOFF
Flood Control Effectiveness of Systems of Dual Purpose Detention Basins,
W83-03350 4A

Mathematical Modeling in Urban Hydrology,
W83-03486 2A

URBAN WATERSHEDS
Urban Flood Damage Estimating Curves,
W83-03294 2E

UREAS
The Uptake of Dissolved Nitrogenous Nutrients by Lake Kinneret (Israel) Microplankton,
W83-03260 2H

USER NEEDS ASSESSMENT
Agricultural Irrigation Technology Transfer Assessment,
W83-03281 3F

USSR
Determination of the Parameters of Large Unlined Canals on the Basis of Hydrologicomorphological Analogy,
W83-03197 8D

Flushing of Reservoirs as a Means of Increasing the Operating Efficiency of Hydroelectric Stations,
W83-03198 8A

Main Results of Investigating Siltation of the Reservoir of the Tereblya-Rika Hyroelectric Station,
W83-03204 2J

Reuse of Treated Municipal Wastewater in the Technical Supply of Industrial Companies in Moscow (Die Wiederverwendung Des Gereinigten Kommunalen Abwasser In Der Technischen Wasserversorgung Der Moskauer Industriebetriebe),
W83-03222 5D

Hygienic Evaluation of Hydrogen Sulfide-Containing Thermal Waters Used in Hot Water Supply Systems (Gigiena Otsenka Serovodnykh Termal'Nykh Vod, Ispol'Zuemykh V Sisteme Goryachego Vodosnabzheniya),
W83-03405 5C

Trace Elements (Manganese, Zinc and Copper) in the USSR Part of the Danube River,
W83-03470 5B

Biological Role of Perch in the Kremenchug Reservoir,
W83-03472 2H

Material and Energy Balance of Organic Matter in the Waters of the Rybinsk Reservoir and Lake Baikal,
W83-03478 2H

Zoobenthos of Lakes of Black Sea Reservation (Preserve),
W83-03479 2H

Hydrobiology of the Littoral Zone of the Dnieper Estuary Under Conditions of Regulated Flow of the River,
W83-03480 6G

VALVES
Keeping the Flow Smooth.
W83-03249 8C

VARIABILITY
Regional Detection of Change in Water Quality Variables,
W83-03295 2A

Analysis of Basin Irrigation Performance with Variable Inflow Rate,
W83-03410 3F

VARIABLE COSTS
Cost and Precision in a Stream Sampling Program,
W83-03336 6C

VELOCITY POTENTIAL
Fluid Mechanics - The Green Function of the Neumann-Kelvin Problem in a Canal,
W83-03188 8B

VERTICAL TUBE CRYSTALLIZERS
The Start-up and Testing of a 6,000 GPD Indirect Freeze Desalination Pilot Plant,
W83-03468 3A

VIRGIN ISLANDS
A Center for the Transfer of Desalination Technology,
W83-03352 3A

VIRGINIA
Chesapeake Bay Nutrient and Plankton Dynamics. 1. Bacterial Biomass and Production During Spring Tidal Destratification in the York River, Virginia, Estuary,
W83-03264 2L

Industrial Effluents as a Source of Mercury Contamination in Terrestrial Riparian Vertebrates,
W83-03402 5B

VIRUSES
Viral Contamination of Seawater at Messina (Inquinamento Di Natura Virale Delle Acque Di Mare Della Citta'Di Messina),
W83-03484 5B

VITRIFICATION
Vitrification of Pure Liquid Water by High Pressure Jet Freezing,
W83-03259 1A

VOLCANIC ASH
Surface Irrigation as Affected by Ash from Mount St. Helens,
W83-03285 2J

VOLUMETRIC ANALYSIS
The Role of Fulvic Substances on Trace Metal Partitioning in Natural Aquatic Sediments,
W83-03348 2K

VORTICES
Inlet Construction for Vortex Drops With Supercritical Inflow (Einlaufkonstruktion Fur Wirbelfallschachte Mit Schiessendem Zufluss),
W83-03481 8B

WALES
Gamekeeper, Poacher--The Welsh Wa Approach,
W83-03219 5F

Modelling the Flood Alleviation Scheme for the Usk at Brecon,
W83-03247 8B

WASHINGTON
Surface Irrigation as Affected by Ash from Mount St. Helens,
W83-03285 2J

Water Quality of the Upper Spokane River and Evaluation of Methods for Measurement of the Effect of Effluent Upon Primary and Secondary Producers,
W83-03317 5A

Control of Algal Dominance Through Changes in Zooplankton Grazing, Lake Washington: Phase I,
W83-03467 5G

WASTE HEAT
Organic Absorbents for Triple Point Absorption Freeze Crystallization Processes,
W83-03341 3A

WASTERWATER TREATMENT
Tree of Knowledge.
W83-03234 5D

WASTEWATER DISPOSAL
Chemical Speciation of Leachates From Waste Disposal Sites,
W83-03432 5B

WASTEWATER FACILITIES
Wastewater Treatment in Rural Areas. There Doesn't Always Have to be a Central Wastewater Treatment Facility (Abwasserreinigung Im Lanlichen Raum. Es Muss Nicht Immer Eine Zentralklaranlage Sein).
W83-03435 5D

Berlin Water '81 -- 125 Years of Central Water Distribution (Wasser Berlin '81 -- 125 Jahre Zentrale Wasserversorgung),
W83-03455 5F

Automation in Wastewater Technology and Water Quality. Practical Experience with Control, Regulation, and Automation in Sewer Systems, Wastewater Treatment, and Water Quality Control (Automation in Der Abwassertechnik und Gewassergute. Praktische Erfahrungen Bei Der Steuerung, Regelung und Automation Bei Der Abwasserableitung, Abwasserbehandlung und Gewasserguteuberwachung,
W83-03469 5D

WASTEWATER TREATMENT
Chemostat Adaptation of Escherichia Coli B/r/1 to Low Water Activity,
W83-03151 5D

The Removal of Salmonella Enteritidis in Activated Sludge,
W83-03152 5D

Removal of Trace Chlorinated Organic Compounds by Activated Carbon and Fixed-Film Bacteria,
W83-03194 5D

Advanced Wastewater Treatment by Ion Exchange,
W83-03196 5D

A Method for Calculating the Dimensions of Long Sewage Force Mains,
W83-03199 5D

Problems of the Load at Veb Zellstoff-Und Papierfabrik Rosenthal (Probleme Der Abwasserlast Im Veb Zellstoff-Und Papierfabrik Rosenthal),
W83-03223 5D

Returning the Tyne to Life,
W83-03231 5D

Wet Oxidation for the Treatment of Toxic Industrial Wastes.
W83-03235 5D

Plastic Tanks: Pitfalls to Avoid,
W83-03250 8G

Use of Anaerobic Digestion in the Agricultural and Food Industries (Application De La Deges-

tion Anaerobie Dans Les Industries Agro-Alimentaires),
W83-03252 5D

The Role of Cationic Surfactants in the Renovation of Water,
W83-03275 5F

Costs of Phosphate Elimination in Municipal Wastewater Facilities (Kosten Der Phosphatelimination in Kommunalen Klaranlagen),
W83-03436 5D

New Design Guidelines for Vertical-Current Final Settling Tanks for Activated Sludge Plants (Neue Bemessungs-Grundlagen Fur Vertikal Durchstromite Nachklarkecken Von Belebungsanlagen),
W83-03437 5D

Anaerobic Activated Sludge Treatment of Filtrates From Thermally Conditioned Sludges (Die Behandling Von Filtratwassern Thermisch Konditionierter Schlamme Nach Anaeroben Belebunsverfahren),
W83-03440 5D

Effect of Precipitation Purification on the Behavior of Sludges During Mechanical Dewatering (Einfluss Der Fallungsreinigung Auf Das Verhalten Von Klarschlammen Bei Der Mechanischen Entwasserung),
W83-03444 5D

Berlin Water '81 -- 125 Years of Central Water Distribution (Wasser Berlin '81 -- 125 Jahre Zentrale Wasserversorgung),
W83-03455 5F

Automation in Wastewater Technology and Water Quality. Practical Experience with Control, Regulation, and Automation in Sewer Systems, Wastewater Treatment, and Water Quality Control (Automation in Der Abwassertechnik und Gewassergute. Praktische Erfahrungen Bei Der Steuerung, Regelung und Automation Bei Der Abwasserableitung, Abwasserbehandlung und Gewasserguteuberwachung,
W83-03469 5D

WASTEWATER TREATMENT FACILITIES
Biological Wastewater Purification with Technical Oxygen (Biologische Abwasserreinigung Mit Techn. Reinem Sauerstoff),
W83-03443 5D

WASTEWATER TREATMENTS
Biological Wastewater Purification with Technical Oxygen (Biologische Abwasserreinigung Mit Techn. Reinem Sauerstoff),
W83-03443 5D

WATER ANALYSIS
Fluorimetric Determination of Chloroform in Drinking Water,
W83-03190 5A

Determination of Total Iodine and Iodate-Iodine in Natural Freshwater,
W83-03206 5A

Accuracy of Determination of Total Oxidised Nitrogen and Nitrite in River Waters: Analytical Quality Control in the Harmonised Monitoring Scheme.
W83-03207 5A

New Approaches to Measuring Total Bacterial Populations in Water Supplies,
W83-03292 5A

The Influence of Sample Treatment on Nutrient Analysis in Eutrophic Waters (Der Einfluss Der Probenbehandlung Auf Die Nahrstoffanalytik Bei Eutrophen Gewassern),
W83-03392 5A

Determination of PAH in Water and Sediments by Low Temperature Fluorimetry (Dosage Des Hydrocarbures Aromatiques Polynucleaires Dan Les Eaux Et Les Sediments Par Fluorimetrie A Basse Temperature),
W83-03413 5A

Inverse-Voltammetry of Some Copper Chelates Using a Carbon Paste Electrode. Determination of Copper in Drinking Water by Oxidation of Copper Dithio-Oxamide (Zur Invers-Voltammetrie Einiger Kupferchelate an Der Kohlepaste-Electrode. Bestimmung Von Kupfer in Trinkwasser Durch Oxidation Von Kupferdithiooxamid),
W83-03415 5A

On the Analysis of Trace Elements Harmful to Humans in River Sediments (Zur Analytik Humangefahrlicher Spurenelemente in Flusssediment),
W83-03442 5A

Tendencies in the Changes in the Saprobic Conditions of the Maritsa River (Tendentsii V Izmenenyata Na Saprobiolodgichnoto Sustoyanie Na Reka Maritsa),
W83-03473 5C

Viral Contamination of Seawater at Messina (Inquinamento Di Natura Virale Delle Acque Di Mare Della Citta'Di Messina),
W83-03484 5B

Application of Kelgraph to Electrochemical Detectors for Flow Injection Analysis and High Performance Liquid Chromatography,
W83-03490 5A

WATER CONDITIONING
Water Management for Packaged Boiler Systems,
W83-03205 5F

WATER CONSERVATION
Water and Energy Conservation Using Center Pivot Irrigation and Reduced Tillage Systems,
W83-03342 3F

The Concord Water Survey,
W83-03351 3D

Irrigation Water Conservation by Using Wide-Spaced Furrows,
W83-03408 3F

WATER CONVEYANCE
Promising Experiments on Leak Location by Means of Correlation (Aussichtsreiche Versuche Zur Leckortung Mittels Korrelation),
W83-03445 5F

Topical Questions on Central Control and Monitoring for Water Supplies (Aktuelle Fragen Bei Zentraler Steuerung Und Uberwachung Von Wasserversorgungen),
W83-03449 5F

Berlin Water '81 -- 125 Years of Central Water Distribution (Wasser Berlin '81 -- 125 Jahre Zentrale Wasserversorgung),
W83-03455 5F

Energy Reclamation from the Drinking Water System with Series-Connected Pumps (Energieruckgewinnung Aus Dem Trinkwassersystem Mit Serienpumpen),
W83-03460 8C

WATER COOLING
Experimental and Analytical Study of Heat Transfer and Mixing in Thermally Stratified Buoyant Flows,
W83-03370 2H

WATER COSTS
Economic Impacts of Transferring Water From Agriculture to Alternative Uses in Colorado,
W83-03303 6D

WATER DEMAND
Irrigation Water Response Function Estimation: An Improved Ridge Regression Methodology,
W83-03302 6D

Economic Impacts of Transferring Water From Agriculture to Alternative Uses in Colorado,
W83-03303 6D

Use of Water in Arkansas, 1980,
W83-03367 6D

Factors Influencing Hourly and Daily Water Demand (Uber Die Stunden-Und Tagewasserbedarf Beeinflussenden Faktoren),
W83-03438 6D

WATER DISTRIBUTION
The Meaning of the Generally Accepted Technological Standards for the Planning, Construction, and Operation of Water Distribution Facilities (Die Bedeutung Der Anerkannten Regeln Der Technik Fur Planung, Bau und Betrieb Von Wasserversorgungsanlagen),
W83-03441 6E

WATER HYACINTH
Effect of Aquatic Macrophytes on Physico-Chemical Parameters of Agricultural Drainage Water,
W83-03153 5G

WATER LAW
Flood Loss Reduction Through Interstate Compacts: An Under-Utilized Approach,
W83-03324 6F

The Escatawpa River - An Interstate Approach to Water Resource Management,
W83-03354 6E

Adapting Appropriation Water Law to Accommodate Equitable Consideration of Instream Flow Uses,
W83-03379 6E

The Meaning of the Generally Accepted Technological Standards for the Planning, Construction, and Operation of Water Distribution Facilities (Die Bedeutung Der Anerkannten Regeln Der Technik Fur Planung, Bau und Betrieb Von Wasserversorgungsanlagen),
W83-03441 6E

Development and Status of Emergency Drinking Water Supply in the Federal Republic of Germany After Passage of the Water Safeguarding Law (Entwicklung und Stand Der Tinkwasser-Notversorgung in Der Bundesrepublik Nach Dem Wassersicherstellungsgesetz),
W83-03458 5F

Overview of Groundwater Law and Institutions in United States Border States,
W83-03496 6E

Texas Groundwater Law: A Survey and Some Proposals,
W83-03497 6E

WATER LOSS
Promising Experiments on Leak Location by Means of Correlation (Aussichtsreiche Versuche Zur Leckortung Mittels Korrelation),
W83-03445 5F

WATER MANAGEMENT
Field Evaluation of a Water Management Simulation Model,
W83-03238 4A

Valves, Penstocks and Actuators: Reliable Control of Water Systems,
W83-03245 5F

Water-Its Role From Now to the Year 2000,
W83-03491 6D

New Mexico Water Law: An Overview and Discussion of Current Issues,
W83-03492 6E

WATER MANAGEMET
Surface Water Quality in the Border Area Between El Paso and the Gulf of Mexico,
W83-03500 5G

WATER POLICY
The Evolution of California State Water Planning 1850-1928,
W83-03274 6E

WATER POLLUTION CONTROL
Quantitative Models and Analysis of Urban Nonpoint Source Water Pollution Control Systems,
W83-03184 6A

WATER POLLUTION EFFECTS
Aquatic Plant Control and Disappearance of Terbutryn from Treated Waters in Ontario, Canada, 1974-1977,
W83-03166 4A

Effects of Simazine Treatment on Channel Catfish Production and Water Quality in Ponds,
W83-03167 5G

The Responses of Plankton Communities in Experimental Ponds to Atrazine, the Most Heavily Used Pesticide in the United States,
W83-03255 5C

Study of the Changes in River Water Quality (Etude De L'Evolution De La Qualite Des Eaux De Riviere),
W83-03267 5B

Changes in Esterase Zymograms of a Planktonic Copepod, Acartia Clausi, in a Polluted Marine Area (Sewage Output of Marseilles) (Modifications Des Zymogrammes Des Esterases D'Un Copepode Planctonique, Acartia Clausi Dans Une Emissaire De Marseille),
W83-03386 5C

Tendencies in the Changes in the Saprobic Conditions of the Maritsa River (Tendentsii V Izmenenyata Na Saprobiolodgichnoto Sustoyanie Na Reka Maritsa),
W83-03473 5C

Species Composition and Distribution of the Macrozoobenthos of the Maritsa River (Vidov Sustav I Razpredelenie Na Makrozoobentosa Ot Reka Maritsa),
W83-03474 5C

The Species Deficit of the Macrozoobenthic Communities as a Criterion for the Transsaprobic Influences on the Maritsa River (Vidoviyat Defitsit Na Makrozoobentosnite Suobshchestva Kato Kriterii Za Transsaprobnite Vliyaniya Vurkhu Reka Maritsa),
W83-03475 5C

WATER POLLUTION SOURCES
Control of Trihalomethanes in Barcelona's Water Supply (Controle Des Trihalomethanes Dans Les Eaux D'Approvisionnement De Barcelone),
W83-03210 5B

The Fate of Antifoulant Organotin Compounds in Water Systems,
W83-03315 5B

Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho--Emphasis: 1974-1978,
W83-03365 5B

Organic Matter Pollution of Groundwater Near Highways (Belastung Des Grundwassers Mit Organischen Stoffen Im Gebiet Von Strassen),
W83-03446 5B

Physical, Chemical, and Biological Characteristics of Lake Omodeo, Part II: Possibility of Using Impounded Water for Supplying Oristano City (Fenomeni Biologici Di Un Lago Artificiale Di Antica Data: Lago Omodeo, Nota II: Sulla Possibilita Di Utilizzare Le Acque Dell'Invaso Per La Alimentazione Idrica Della Citta Di Oristano),
W83-03477 5F

Macro and Trace-Elements in Drinking Water and Foods. Part 2 (Macro Ed Oligoelementi Nell'Apporto Idrico Ed Alimentare. Nota 2),
W83-03483 5B

WATER PRESSURE
Possibility of Reducing Energy Costs for Water Conveyance Using a Preliminary Reservoir (Einsparmoglichkeit an Energiekosten Zur Wasserforderung Durch Einsatz Eines Vorbehalters),
W83-03459 8A

Energy Reclamation from the Drinking Water System with Series-Connected Pumps (Energierueckgewinnung Aus Dem Trinkwassersystem Mit Serienpumpen),
W83-03460 8C

WATER PURIFICATION
A Novel Bactericidal Agent for Treatment of Water,
W83-03337 5F

WATER QUALITY
Soil Conservation and Water Quality Improvement: What Farmers Think,
W83-03161 4D

Water Management for Packaged Boiler Systems,
W83-03205 5F

Ecological Assessment of Water Quality: Comparison of Biological-Ecological Procedures in a Rain-Fed Lowland Waterway (Kleine Nete, N. Belgium),
W83-03214 5C

Fish Farm Effluents--Cause for Concern,
W83-03237 5B

Study of the Changes in River Water Quality (Etude De L'Evolution De La Qualite Des Eaux De Riviere),
W83-03267 5B

Regional Detection of Change in Water Quality Variables,
W83-03295 2A

Effects of Silvicultural Practices on Water Quality in Northern Wisconsin,
W83-03304 5G

Hydrology of Area 14, Eastern Coal Province, Kentucky,
W83-03355 7C

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigtion. Part 3: Canadian, North Canadian, and Deep Fork River Basins through 1979,
W83-03362 7C

Chemical-Quality Reconnaissance of the Water and Surficial Bed Material in the Delaware River Estuary and Adjacent New Jersey Tributaries, 1980-81,
W83-03363 2L

Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho--Emphasis: 1974-1978,
W83-03365 5B

Effects of Coal Burning in New Mexico on Air Quality and Surface Water Quality: Raton Study Area,
W83-03382 2K

Macro and Trace-Elements in Drinking Water and Foods. Part 2 (Macro Ed Oligoelementi Nell'Apporto Idrico Ed Alimentare. Nota 2),
W83-03483 5B

Surface Water Quality in the Border Area Between El Paso and the Gulf of Mexico,
W83-03500 5G

WATER QUALITY CONTROL
Effect of Aquatic Macrophytes on Physico-Chemical Parameters of Agricultural Drainage Water,
W83-03153 5G

Effects of Simazine Treatment on Channel Catfish Production and Water Quality in Ponds,
W83-03167 5G

Water Quality of the Upper Spokane River and Evaluation of Methods for Measurement of the Effect of Effluent Upon Primary and Secondary Producers,
W83-03317 5A

Automation in Wastewater Technology and Water Quality. Practical Experience with Control, Regulation, and Automation in Sewer Systems, Wastewater Treatment, and Water Quality Control (Automation in Der Abwassertechnik und Gewassergute. Praktische Erfahrungen Bei Der Steuerung, Regelung und Automation Bei Der Abwasserableitung, Abwasserbehandlung und Gewasserguteuberwachung,
W83-03469 5D

Drinking Water Contamination with Chloro-Organic Compounds: Sources, Health Effects, Control (Contaminazione Delle Acque Potabili Da Composti Cloro-Organici: Origine, Effetti Biologici, Misure Di Protezione E Di Controllo),
W83-03476 5F

WATER QUALITY STANDARDS
Water Quality of Airport Storm Runoff,
W83-03353 5B

WATER REQUIREMENTS
Water Availability in the New Mexico Upper Rio Grande Basin to the Year 2000,
W83-03493 6D

Anticipating Transboundary Water Needs and Issues in the Mexico-United States Border Region in the Rio Grande Basin,
W83-03495 6D

WATER RESOURCES DEVELOPMENT
Multiple Use Reservoir Planning Approaches: Lac Seul, Northwestern Ontario,
W83-03211 6A

The Megget Scheme.
W83-03248 8A

WATER RESOURCES DEVELOPMENT. *FISHERIES
Fisheries Productivity and Water Level Fluctuations in Lac Seul, Northwestern Ontario,
W83-03212 6G

WATER RETENTION
Undisturbed Core Method for Determining and Evaluating the Hydraulic Conductivity of Unsaturated Sediments,
W83-03319 2G

WATER REUSE
Water Reuse and Recycling in the Textile Industry,
W83-03178 3E

Reuse of Treated Municipal Wastewater in the Technical Supply of Industrial Companies in Moscow (Die Wiederverwendung Des Gereinigten Kommunalen Abwasser In Der Technischen Wasserversorgung Der Moskauer Industriebetriebe),
W83-03222 5D

Optimum Irrigation Loading Rates of Highly Saline Wastewater on a Montmorillonitic Soil,
W83-03327 3C

Water Reuse in the Coastal Plain of New Jersey - A Case Study,
W83-03378 3C

WATER RIGHTS
Adapting Appropriation Water Law to Accommodate Equitable Consideration of Instream Flow Uses,
W83-03379 6E

New Mexico Water Law: An Overview and Discussion of Current Issues,
W83-03492 6E

California Groundwater Management: The Sacred and the Profane,
W83-03498 6E

WATER SAMPLING
Heavy Metals in Flowing Waters and River Sediments of the Western Harz Region (Schwermetalle in Den Fliessgewassern Und Flusssedimenten Des West-Harzes,
W83-03457 5B

WATER SHORTAGE
The Concord Water Survey,
W83-03351 3D

WATER SOFTENING
Effect of Iron as a Trace Impurity on the Water Softening Process,
W83-03411 5F

WATER STORAGE
Water Storage Capacity of Natural Wetland Depressions in the Devils Lake Basin of North Dakota,
W83-03160 2H

Plastic Tanks: Pitfalls to Avoid,
W83-03250 8G

Multi-Purpose Storage Systems: Objective, Conflicts, Alternatives,
W83-03424 6A

WATER STRESS
Automated Strain Gage Dendrography for Improved Water Utilization in Plants,
W83-03372 2I

WATER SUPPLY
Mathematical Model for Long-Term Water Supply Planning (Mathematisches Modell Fur Die Langfristige Wasserversorgungsplanung),
W83-03224 6A

The Zurich Water Supply System,
W83-03229 5F

Water Supply for the Lizard.
W83-03246 5F

The Megget Scheme.
W83-03248 8A

Water Quality of Airport Storm Runoff,
W83-03353 5B

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigtion. Part 3: Canadian, North Canadian, and Deep Fork River Basins through 1979,
W83-03362 7C

Development and Status of Emergency Drinking Water Supply in the Federal Republic of Germany After Passage of the Water Safeguarding Law (Entwicklung und Stand Der Tinkwasser-Notversorgung in Der Bundesrepublik Nach Dem Wassersicherstellungsgesetz),
W83-03458 5F

Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

Anticipating Transboundary Water Needs and Issues in the Mexico-United States Border Region in the Rio Grande Basin,
W83-03495 6D

California Groundwater Management: The Sacred and the Profane,
W83-03498 6E

WATER TABLE DECLINE
The Effects of Altered Hydrologic Regime on Tree Growth Along the Missouri River in North Dakota,
W83-03262 6G

WATER TEMPERATURE
Efficient Utilization of Industrial Waster and Waste Heat for Intensive Fish Production (Die Rationelle Nutzung Von Industriewasser Und Abwarme Fur Eine Intensive Fischproduktion),
W83-03221 3C

Trans-Boundary Geothermal Resources of Texas and Mexico,
W83-03499 2F

WATER TREATMENT
The Efficacy of Removal of Heavy Metals from Water by Calcite,
W83-03157 5F

Molecular Size Determination of Chloroform Precursors,
W83-03187 5A

How Pulsators and Superpulsators Can Improve the Water Treatment Process,
W83-03220 5F

Mother Nature as Sludge Thickener,
W83-03227 5F

Prechlorination and Trihalomethane Formation at Water Treatment,
W83-03228 5F

Fit to Drink,
W83-03236 5F

Final Results of Testing of Abcor 8 Inches Spiral Wound Ultra-Filters at The Wrightsville Beach Test Facility,
W83-03288 3A

Removal of Nitrate, Sulfate and Hardness from Groundwater by Ion Exchange,
W83-03290 5F

New Approaches to Measuring Total Bacterial Populations in Water Supplies,
W83-03292 5A

A Novel Bactericidal Agent for Treatment of Water,
W83-03337 5F

UV-Ozone Process for the Concurrent Decomposition of Halogenated Alkanes and the Disinfection of Water,
W83-03338 5F

Optimization and Dynamic Control of the Coagulation Process in Water Treatment,
W83-03373 5F

Effect of Iron as a Trace Impurity on the Water Softening Process,
W83-03411 5F

Trihalomethane Removal and Formation Mechanism in Water,
W83-03430 5F

Monitoring Flocculation in Water Treatment Using a Computer-Controlled Physical Model (Uberwachung der Wasseraufbereitung Mit Hilfe Eines Rechnergesteuerten Physikalischen Modells),
W83-03439 5F

Use of Polyethylene Imines in Flotation and Improving the Filtration of Suspensions of Blue-Green Algae,
W83-03471 5F

WATER TREATMENT FACILITIES
Water Plant Grows Bigger, Cuts Electric Bill.
W83-03226 5F

Water Supply for the Lizard.
W83-03246 5F

Berlin Water '81 -- 125 Years of Central Water Distribution (Wasser Berlin '81 -- 125 Jahre Zentrale Wasserversorgung),
W83-03455 5F

WATER USE
Efficient Use of Water for Irrigation in the Upper Midwest,
W83-03282 6D

Economic Impacts of Transferring Water From Agriculture to Alternative Uses in Colorado,
W83-03303 6D

Use of Water in Arkansas, 1980,
W83-03367 6D

Factors Influencing Hourly and Daily Water Demand (Uber Die Stunden-Und Tagewasserbedarf Beeinflussenden Faktoren),
W83-03438 6D

Water Availability in the New Mexico Upper Rio Grande Basin to the Year 2000,
W83-03493 6D

WATER UTILIZATION
Automated Strain Gage Dendrography for Improved Water Utilization in Plants,
W83-03372 2I

WATER YIELD
Hydrologic Flow Determination for Hydropower Feasibility Analysis,
W83-03271 2E

Basin-Scale Evapotranspiration Determination through Watershed and Climate Analyses,
W83-03328 2D

WATERFOWL
Forests, Wetlands and Waterfowl Populations in the Turtle Mountains of North Dakota and Manitoba,
W83-03181 2L

WATERSHED MANAGEMENT
Index Construction for Multiple Objective Analysis of Land and Water Use in a High Mountain Watershed,
W83-03286 6A

The Costs and Benefits of Soil Erosion Control in the North Lake Chicot Watershed,
W83-03331 4D

WATERSHED PROTECTION
The Flood Mitigation Potential of Inland Wetlands,
W83-03349 6A

WATERSHEDS
Response Surface Parameter Sensitivity Analysis Methods for Postcalibration Studies,
W83-03293 2A

WAVES
Managing for Waves on Nebraska's Lake McConaughy - An Overview,
W83-03426 8A

WEATHER
Contribution to the Measurement of Evaporation in Remote Stations (Beitrag Zur Verdunstungsmessung in Abgelegenen Stationen),
W83-03225 7B

WEATHER PATTERNS
Rainfall Cell Size From Rit Curve Analysis,
W83-03339 2B

WEEDS
Efficiency of Water Use by Crops Under Allelopathy Stress,
W83-03313 2I

WEIRS
Hydraulic Criteria for the Design of Weir Sills (Hydraulische Entwurfs- Und Bemessungskriterien fur Sohlschwellen),
W83-03241 8B

WELL DATA
Ground Water Quantity and Quality in Fracture Zones in Abbeville County, South Carolina,
W83-03466 3B

WESTERN U.S
Adapting Appropriation Water Law to Accommodate Equitable Consideration of Instream Flow Uses,
W83-03379 6E

WET OXIDATION
Wet Oxidation for the Treatment of Toxic Industrial Wastes.
W83-03235 5D

WETLANDS
Water Storage Capacity of Natural Wetland Depressions in the Devils Lake Basin of North Dakota,
W83-03160 2H

Forests, Wetlands and Waterfowl Populations in the Turtle Mountains of North Dakota and Manitoba,
W83-03181 2L

Use of Hedonic Price Technique to Evaluate Wetlands,
W83-03343 6B

The Flood Mitigation Potential of Inland Wetlands,
W83-03349 6A

WHEAT
Field Study of Actual Evapotranspiration of a Wheat Crop (Etude 'In Situ' De L'Evapotranspiration Reelle D'une Culture De Ble),
W83-03389 2D

WILD RIVERS
Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

WILDERNESS AREAS
Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

WILDLIFE CONSERVATION
Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

WILDLIFE HABITATS
Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

WILDLIFE MANAGEMENT
Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

WINTERKILL
Artificial Destratification to Prevent Winterkill,
W83-03299 5G

WISCONSIN
Effects of Silvicultural Practices on Water Quality in Northern Wisconsin,
W83-03304 5G

The Groundwater Budget of Lake Wingra, Dane County, Wisconsin,
W83-03305 2F

Soil Conservation and the Reduction of Erosion and Sedimentation in the Coon Creek Basin, Wisconsin,
W83-03356 4D

WITHDRAWALS
Effects of Groundwater Pumpage on Surface and Groundwater Flows on Adjoining Basins,
W83-03431 4B

WYOMING
Verification of Step-Backwater Computations on Ephemeral Streams in Northeastern Wyoming,
W83-03366 2E

X-RAY DIFFRACTION PATTERNS
Vitrification of Pure Liquid Water by High Pressure Jet Freezing,
W83-03259 1A

X-RAY FLUORESCENCE
Trace Toxic Metals Determination in Natural Waters Using X-Ray Fluorescence Spectrometry on a Chelating Resin Captor (Determination De Traces Metaux Toxiques Dans Les Eaux Naturelles Par Spectrometrie De Fluorescence X Sur Capteur De Resine Chelatante),
W83-03414 5A

X-RAY SPECTROSCOPY
Characterization of Kel-F-Graphite Composite (Kelgraf) Electrodes and Application to Detection in Flowing Streams,
W83-03369 7B

AUTHOR INDEX

ADAMS, V. D.
An Experimental Investigation of the Effects of Crude Oil on Two Freshwater Lake Ecosystems,
W83-03273 5C

AGUILAR, E.
Geohydrology of the Rio Camuy Cave System, Puerto Rico,
W83-03283 2F

AHLERT, R. C.
Physiochemical Pretreatment of Landfill Leachates Using Coagulation,
W83-03172 5G

Water Reuse in the Coastal Plain of New Jersey - A Case Study,
W83-03378 3C

AHRENS, K.
Monitoring Flocculation in Water Treatment Using a Computer-Controlled Physical Model (Uberwachung der Wasseraufbereitung Mit Hilfe Eines Rechnergesteuerten Physikalischen Modells),
W83-03439 5F

AHUJA, L. R.
The Extent and Nature of Rainfall-Soil Interaction in the Release of Soluble Chemicals to Runoff,
W83-03170 5B

ALBRECHT, D. R.
Nutrient Contents and Algal Growth in an Impounded River: Effects on Oxygen Balance and need for Nutrient Retention (Nahrstoffgehalte und Algenwachstum in Einem Gestauten Fluss, Auswirkungen Auf Die Sauerstoffbilanz Und Notwendigkeit Des Nahrstoffruckhaltes),
W83-03454 5C

ALCAIDE, E.
Improved Salmonella Recovery from Moderate to Highly Polluted Waters,
W83-03164 5A

ALLEN, P. G.
Use of Hedonic Price Technique to Evaluate Wetlands,
W83-03343 6B

ALLNUTT, F. C. T.
In Situ Nitrogen (C2H2) Fixation in Lakes of Southerm Victoria Land, Antarctica,
W83-03203 2H

ANAGNOSTOPOULOS, G. D.
Chemostat Adaptation of Escherichia Coli B/r/1 to Low Water Activity,
W83-03151 5D

ANDERSON, M. P.
The Groundwater Budget of Lake Wingra, Dane County, Wisconsin,
W83-03305 2F

ANDREPONT, J. S.
Fabrication of a 6,000 GPD Indirect Freezing Pilot Plant: Vol. 1,
W83-03462 3A

ANDREWS, B.
California Groundwater Management: The Sacred and the Profane,
W83-03498 6E

ANDREWS, J. N.
Radioelements, Radiogenic Helium and Age Relationships for Groundwaters From the Granites at Stripa, Sweden,
W83-03208 2F

ANESES, N.
An Assessment of the Use Potential of the Flow of Water at the Spring 'Ojo de Agua' in Aguadilla, Puerto Rico,
W83-03321 4B

ANGINO, E. E.
Chemical Effects of Selected Trace-Metals From Sanitary Landfill Leachates on Groundwater Quality,
W83-03340 5E

ANTROPOVSKII, V. I.
Determination of the Parameters of Large Unlined Canals on the Basis of Hydrologicomorphological Analogy,
W83-03197 8D

ARCE, R.
Evaluation and Accessing of Data for a Water Resources Simulator,
W83-03334 7A

ARFI, F.
Response Surface Parameter Sensitivity Analysis Methods for Postcalibration Studies,
W83-03293 2A

ARMSTRONG, N. E.
Anticipating Transboundary Water Needs and Issues in the Mexico-United States Border Region in the Rio Grande Basin,
W83-03495 6D

ARNORSSON, S.
The Chemistry of Geothermal Waters in Iceland. I. Calculation of Aqueous Specification from 0 to 370C,
W83-03201 2K

ARON, G.
On-Site Sewage Disposal: Site Suitability, System Selection and Soil Absorption Area Sizing,
W83-03268 5D

ARTHUR, W.
A Center for the Transfer of Desalination Technology,
W83-03352 3A

ATTMANNSPACHER, W.
Opportunities and Potential Benefits of Radar Rainfall Measurements for the Federal Republic of Germany (Moglichkeiten und Potentieller Nutzen Eines Bundesdeutschen Niederschlagsradar--Verbundsystems),
W83-03240 7B

AUSTRING, A.
Rainfall Cell Size From Rit Curve Analysis,
W83-03339 2B

AVNIMELECH, Y.
Evaluating the Release of Soluble Components from Sediment,
W83-03168 5B

AWAJI, T.
Water Mixing in a Tidal Current and the Effect of Turbulence on Tidal Exchange Through a Strait,
W83-03159 2L

AWERBUCH, L.
Parametric Study of Seawater Reverse Osmosis Desalting Plants,
W83-03316 3A

AZOYAN, S. A.
Use of Polyethylene Imines in Flotation and Improving the Filtration of Suspensions of Blue-Green Algae,
W83-03471 5F

BACHMANN, R. W.
Agricultural Stream Ecosystems: Structure and Function for Understanding Water Quality Improvements,
W83-03377 6G

A Survey of Water Transparency in Iowa Lakes,
W83-03371 5C

BAGLEY, J. M.
Adapting Appropriation Water Law to Accommodate Equitable Consideration of Instream Flow Uses,
W83-03379 6E

BAILLE, A.
The Use of Industrial Waste Water. I. Aerial and Soil Microclimatic Modifications Due to Heating by Wastewater (20 Degrees C) Circulating in Buried Pipes (Utilisation Des Eaus De Rejet En Agriculture, I. Modifications Microclimatiques Dues Au Chauffage Du Sol Par Tuyaux Enterres, En Plein Champ)
W83-03388 3C

BAKER, J. L.
Effect of Incorporation of Fall-Applied Fertilizer on Runoff Losses of Nutrients and Soil From Soybean Ground,
W83-03298 2J

BAKER, K. H.
New Approaches to Measuring Total Bacterial Populations in Water Supplies,
W83-03292 5A

BALLENTINE, R. J.
Numerical Simulation of Land-Breeze-Induced Snowbands Along the Western Shore of Lake Michigan,
W83-03482 2C

BALRAM, A.
Trihalomethane Removal and Formation Mechanism in Water,
W83-03430 5F

BARAKAH, A.
A Computer Model for Predicting the Impact of Irrigating with Saline Water on Soils and Runoff Water in Missouri,
W83-03284 3C

BARBIERI, G.
Effect of Irrigation and Harvesting Dates on the Yield of Spring-Sown Sugar-Beet,
W83-03383 3F

BARFIELD, B. J.
Effects of Surface Application of Dairy Manure on the Infiltration Rate and Quality of Surface Runoff,
W83-03344 5B

BARNUM, J. B.
Agricultural Stream Ecosystems: Structure and Function for Understanding Water Quality Improvements,
W83-03377 6G

BARRACLOUGH, J. T.
Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho--Emphasis: 1974-1978,
W83-03365 5B

BARTAK, D. E.
Determination of the Complexing Capacity of Water Systems by Gel Chromatographic and Electrochemical Techniques,
W83-03185 5A

BEARDALL, J.
A Seasonal Study of the Distributions of Surface State Variables in Liverpool Bay. III. An Offshore Front,
W83-03173 2L

BEATTIE, B. R.
Irrigation Water Response Function Estimation: An Improved Ridge Regression Methodology,
W83-03302 6D

BECKER, L.
Worth of Inflow Forecast for Reservoir Operation,
W83-03296 4A

BEHNIA, M.
Experimental and Analytical Study of Heat Transfer and Mixing in Thermally Stratified Buoyant Flows,
W83-03370 2H

BELMANS, C.
Obtaining Soil Physical Field Data for Simulating Soil Moisture Regimes and Associated Potato Growth,
W83-03390 2G

BELTMAN, B.
Sampling Macrofauna in Ditches,
W83-03217 7B

BENDER, A. R.
Wind Energy for Low Head Irrigation,
W83-03309 8C

BENHAM, E. C.
Efficient Use of Water for Irrigation in the Upper Midwest,
W83-03282 6D

BERGO, D. A.
Removal of Nitrate, Sulfate and Hardness from Groundwater by Ion Exchange,
W83-03290 5F

BERMAN, T.
The Uptake of Dissolved Nitrogenous Nutrients by Lake Kinneret (Israel) Microplankton,
W83-03260 2H

BERUASHVILI, T. A.
Hygienic Evaluation of Hydrogen Sulfide-Containing Thermal Waters Used in Hot Water Supply Systems (Gigiena Otsenka Serovodnykh Termal'Nykh Vod, Ispol'Zuemykh V Sisteme Goryachego Vodosnabzheniya),
W83-03405 5C

BESCHTA, R. L.
Dynamic Modelling of Suspended Sediment Transport in Streams as a Function of Sediment Supply,
W83-03368 2J

BEVERIDGE, M.
An Evaluation of Proposed Cage Fish Culture on Loch Lomond, An Important Reservoir in Central Scotland,
W83-03403 6G

BICKY, T. J.
Phosphate Release in Laboratory Soil Columns,
W83-03301 5B

BILLIB, H. A.
Mathematical Model for Long-Term Water Supply Planning (Mathematisches Modell Fur Die Langfristige Wasserversorgungsplanung),
W83-03224 6A

BIROS, D. J.
Tufa Precipitation and its Effect on Drainage of Interstate Highways in Northeastern Ohio,
W83-03213 5B

BISCHOFF, J. H.
Optimum Irrigation Loading Rates of Highly Saline Wastewater on a Montmorillonitic Soil,
W83-03327 3C

BLACKBURN, W. H.
Assessment of Stormflow and Water Quality From Undisturbed and Site Prepared Forest Land in East Texas,
W83-03277 4C

BLANCHAR, R. W.
A Computer Model for Predicting the Impact of Irrigating with Saline Water on Soils and Runoff Water in Missouri,
W83-03284 3C

BOARI, G.
Advanced Wastewater Treatment by Ion Exchange,
W83-03196 5D

BOTTOM, J. D.
Effects of Surface Application of Dairy Manure on the Infiltration Rate and Quality of Surface Runoff,
W83-03344 5B

BOUCHAUD, M.
Study of the Changes in River Water Quality (Etude De L'Evolution De La Qualite Des Eaux De Riviere),
W83-03267 5B

BOUMA, J.
Obtaining Soil Physical Field Data for Simulating Soil Moisture Regimes and Associated Potato Growth,
W83-03390 2G

BOUWER, E. J.
Removal of Trace Chlorinated Organic Compounds by Activated Carbon and Fixed-Film Bacteria,
W83-03194 5D

BRAMMER, J. D.
Identification and Quantification of Water Soluble Components of Outboard Motor Exhaust and of Gasoline in a North Dakota Lake,
W83-03428 5A

BRANDVOLD, D. J.
An Evaluation of Sediments in the Middle Rio Grande, Elephant Butte Reservoir, and Caballo Reservoir as Potential Sources for Toxic Meterials,
W83-03322 5B

BRANDVOLD, D. K.
Effects of Coal Burning in New Mexico on Air Quality and Surface Water Quality: Raton Study Area,
W83-03382 2K

BRANDVOLD, L. A.
Effects of Coal Burning in New Mexico on Air Quality and Surface Water Quality: Raton Study Area,
W83-03382 2K

An Evaluation of Sediments in the Middle Rio Grande, Elephant Butte Reservoir, and Caballo Reservoir as Potential Sources for Toxic Meterials,
W83-03322 5B

BRANSON, F. A.
Effects of Increased Precipitation and Grazing Management on Northeastern Montana Rangelands,
W83-03174 4D

BRIGHOUSE, B.
Modelling the Flood Alleviation Scheme for the Usk at Brecon,
W83-03247 8B

BROWN, A. V.
Effects of Sewage Pollution in the White River, Arkansas on Benthos and Leaf Detritus Decomposition,
W83-03332 5C

BROWN, C. S.
Calving Speed of Alaska Tidewater Glaciers, With Application to Columbia Glacier,
W83-03358 2C

BRUA, S. A.
Johnstown-Western Pennsylvania Storm and Floods of July 19-20, 1977,
W83-03357 2E

BRUGAM, R. B.
Post-Mining Neutralization of Acidic Surface Mine Lakes,
W83-03278 5B

BRUGGELLER, P.
Vitrification of Pure Liquid Water by High Pressure Jet Freezing,
W83-03259 1A

BRUSSOCK, P. P.
Effects of Sewage Pollution in the White River, Arkansas on Benthos and Leaf Detritus Decomposition,
W83-03332 5C

BRUTSAERT, W. F.
Radon-222 in Potable Water Supplies in Maine: The Geology, Hydrology, Physics and Health Effects,
W83-03308 2K

BRUWER, C. A.
Multipurpose Use of an Eutrophic South African Man-Made Reservoir,
W83-03425 6D

BRUYLANTS, B.
Ecological Assessment of Water Quality: Comparison of Biological-Ecological Procedures in a Rain-Fed Lowland Waterway (Kleine Nete, N. Belgium),
W83-03214 5C

BUDGE, T. K.
Landsat Monitoring of Irrigated Farmland Acreage in Curry County, New Mexico,
W83-03310 7A

BUKHIN, M. N.
Main Results of Investigating Siltation of the Reservoir of the Tereblya-Rika Hyroelectric Station,
W83-03204 2J

BULATOV, G. YA.
Evaluating the Reliability of Earth Dams According to the Second Group of Limit States (Method of Predicting Dam Behavior),
W83-03218 8D

BURAS, N.
Multi-Purpose Storage Systems: Objective, Conflicts, Alternatives,
W83-03424 6A

BURGER, C. P.
Automated Strain Gage Dendrography for Improved Water Utilization in Plants,
W83-03372 2I

BURKETT, H. D.
A Novel Bactericidal Agent for Treatment of Water,
W83-03337 5F

BURT, O. R.
Irrigation Water Response Function Estimation: An Improved Ridge Regression Methodology,
W83-03302 6D

BUSCH, R. L.
Effects of Simazine Treatment on Channel Catfish Production and Water Quality in Ponds,
W83-03167 5G

BUSNAINA, A. A.
Computer Simulation of Local Destratification in Reservoirs,
W83-03279 5G

CAIRNS, D. J.
Production and Decomposition of Forest Litter Fall on the Apalachicola River Flood Plain, Florida,
W83-03364 5B

CALDERON, A.
An Assessment of the Use Potential of the Flow of Water at the Spring 'Ojo de Agua' in Aguadilla, Puerto Rico,
W83-03321 4B

CAMPANA, M. E.
Environmental Isotopic and Hydrogeochemical Investigation of Recharge and Subsurface Flow in Eagle Valley, Nevada,
W83-03380 2F

CAMPBELL, K. L.
Effect of Aquatic Macrophytes on Physico-Chemical Parameters of Agricultural Drainage Water,
W83-03153 5G

CANFIELD, C.
Mother Nature as Sludge Thickener,
W83-03227 5F

CARLSON, C. G.
Optimum Irrigation Loading Rates of Highly Saline Wastewater on a Montmorillonitic Soil,
W83-03327 3C

CARLSON, M. A.
Post-Mining Neutralization of Acidic Surface Mine Lakes,
W83-03278 5B

CARTWRIGHT, K.
Undisturbed Core Method for Determining and Evaluating the Hydraulic Conductivity of Unsaturated Sediments,
W83-03319 2G

CASSIDY, R. A.
A Public Participation Decision to Fill a Pacific Northwest Reservoir,
W83-03423 6D

CAULLET, C.
Polarographic Determination of Low Levels of Cyanide and Metals in the Waste-Waters Discharged by an Electroplating Plant (Dosages Polarographiques de Faibles Quantities D'Ions Cyanure et de Metaux Dans Les Euax Rejetees Par un Atelier de Galvanoplastie),
W83-03412 5A

CHAKRAVERTY, S.
Post-Mining Neutralization of Acidic Surface Mine Lakes,
W83-03278 5B

CHANDESRIS, J.
Use of Anaerobic Digestion in the Agricultural and Food Industries (Application De La Degestion Anaerobie Dans Les Industries Agro-Alimentaires),
W83-03252 5D

CHANG, E.
Modelling the Flood Alleviation Scheme for the Usk at Brecon,
W83-03247 8B

CHAPPELL, C. F.
Johnstown-Western Pennsylvania Storm and Floods of July 19-20, 1977,
W83-03357 2E

CHAWLA, R. C.
Trihalomethane Removal and Formation Mechanism in Water,
W83-03430 5F

CHERY, D. L.
Field Rating Evaluation of a Large Supercritical Measurement Flume,
W83-03239 7B

CHIAN, E. S. K.
Identification and Assessment of Effluent Residuals in Treated Leachate from Landfill Disposal Sites,
W83-03272 5E

CHRISTAKOS-COMACK, E.
Water Quality of Airport Storm Runoff,
W83-03353 5B

CHRISTENSEN, L. A.
Soil Conservation and Water Quality Improvement: What Farmers Think,
W83-03161 4D

CIANO, V.
Viral Contamination of Seawater at Messina (Inquinamento Di Natura Virale Delle Acque Di Mare Della Citta'Di Messina),
W83-03484 5B

CIEZAK, J.
Factors Influencing Hourly and Daily Water Demand (Uber Die Stunden-Und Tagewasserbedarf Beeinflussenden Faktoren),
W83-03438 6D

CIOGLIA, A. M.
Physical, Chemical, and Biological Characteristics of Lake Omodeo, Part II: Possibility of Using Impounded Water for Supplying Oristano City (Fenomeni Biologici Di Un Lago Artificiale Di Antica Data: Lago Omodeo, Nota II: Sulla Possibilita Di Utilizzare Le Acque Dell'Invaso Per La Alimentazione Idrica Della Citta Di Oristano),
W83-03477 5F

CLANET, F.
Trace Toxic Metals Determination in Natural Waters Using X-Ray Fluorescence Spectrometry on a Chelating Resin Captor (Determination De Traces Metaux Toxiques Dans Les Eaux Naturelles Par Spectrometrie De Fluorescence X Sur Capteur De Resine Chelatante),
W83-03414 5A

CLARK, R. E.
Overview of Groundwater Law and Institutions in United States Border States,
W83-03496 6E

CLYMA, W.
Analysis of Basin Irrigation Performance with Variable Inflow Rate,
W83-03410 3F

COCCHIONI, M.
Macro and Trace-Elements in Drinking Water and Foods. Part 2 (Macro Ed Oligoelementi Nell'Apporto Idrico Ed Alimentare. Nota 2),
W83-03483 5B

CONNOR, D. M.
Citizen Participation in the Design and Management of Reservoirs,
W83-03418 6A

CONTU, A.
Physical, Chemical, and Biological Characteristics of Lake Omodeo, Part II: Possibility of Using Impounded Water for Supplying Oristano City (Fenomeni Biologici Di Un Lago Artificiale Di Antica Data: Lago Omodeo, Nota II: Sulla Possibilita Di Utilizzare Le Acque Dell'Invaso Per La Alimentazione Idrica Della Citta Di Oristano),
W83-03477 5F

CONVERSE, J. W.
The Impact of Institutional Structure and Citizen Participation on Water Resource Planning in Western Kansas,
W83-03330 6D

CONWAY, C. M.
The Phytoplankton Ecology of Devils Lake,
W83-03180 2H

COSSER, P. R.
Lagoon Algae and the BOD Test,
W83-03400 5A

CRAWLEY, W. W.
Assessment of Stormflow and Water Quality From Undisturbed and Site Prepared Forest Land in East Texas,
W83-03277 4C

CROSS, T. K.
Artificial Destratification to Prevent Winterkill,
W83-03299 5G

CUTTER, G. A.
Selenium in Reducing Waters,
W83-03266 5B

DAI, X. -D.
Management of Human Excreta,
W83-03191 5D

DALBY, C.
Evaluation and Monitoring of the Hydrologic Impact of Cabin Creek, B.C. Coal Pit Mining on the North Fork of the Flathead River,
W83-03325 6G

DAMM, M. V.
Investigative Programs for Designing and Modeling Mine Water Control Systems,
W83-03265 4B

DAWSON, P. J.
A Meteorological and Climatological Approach in Determining Snowpack Accumulation at Snow Course Sites in a Montana Watershed,
W83-03465 2A

DAY, L. R.
Radioactivity in Water from the River Lea,
W83-03401 5A

DE GUELDRE, G.
Ecological Assessment of Water Quality: Comparison of Biological-Ecological Procedures in a Rain-Fed Lowland Waterway (Kleine Nete, N. Belgium),
W83-03214 5C

DE MORAES LEME, C. R.
Building Brazil's Nova Avanhandava Dam,
W83-03253 8A

DEBO, T. N.
Urban Flood Damage Estimating Curves,
W83-03294 2E

DEBOER, D. W.
Tillage and Irrigation Management Practices for Optimum Crop Production,
W83-03329 3F

DECKER, K.
Horses in Suburbia,
W83-03176 5G

DEHAVEN, M. G.
Assessment of Stormflow and Water Quality From Undisturbed and Site Prepared Forest Land in East Texas,
W83-03277 4C

DEKHTYAR, M. N.
Hydrobiology of the Littoral Zone of the Dnieper Estuary Under Conditions of Regulated Flow of the River,
W83-03480 6G

DEKKER, L. W.
Obtaining Soil Physical Field Data for Simulating Soil Moisture Regimes and Associated Potato Growth,
W83-03390 2G

DELLEUR, J. W.
Mathematical Modeling in Urban Hydrology,
W83-03486 2A

DELONCLE, R.
Trace Toxic Metals Determination in Natural Waters Using X-Ray Fluorescence Spectrometry on a Chelating Resin Captor (Determination De Traces Metaux Toxiques Dans Les Eaux Naturelles Par Spectrometrie De Fluorescence X Sur Capteur De Resine Chelatante),
W83-03414 5A

DENNEHY, K. F.
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-5A, H-5B, and H-5C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03360 2K

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-6A, H-6B, and H-6C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03361 2K

DENNIS, W. H. JR.
Biodegradation of 1,3-Dinitrobenzene,
W83-03155 5B

DENOYELLES, F.
The Responses of Plankton Communities in Experimental Ponds to Atrazine, the Most Heavily Used Pesticide in the United States,
W83-03255 5C

DHAVISES, G.
Chemostat Adaptation of Escherichia Coli B/r/ 1 to Low Water Activity,
W83-03151 5D

DI PIETRO, A.
Viral Contamination of Seawater at Messina (Inquinamento Di Natura Virale Delle Acque Di Mare Della Citta'Di Messina),
W83-03484 5B

DICKEY, E. C.
Conservation of Soil, Water, andd Energy Through Reduced Tillage Systems - Phase I sub 1,
W83-03287 4D

DILLON, C. R.
Investigation Into Effective Control Methods for Brazilian Elodea (Egeria Densa Planchon) in Lake Marion, S.C.,
W83-03433 4A

DO, C.
Fluid Mechanics - The Green Function of the Neumann-Kelvin Problem in a Canal,
W83-03188 8B

DOWNEY, P. C.
Aquaculture Techniques: A Production Forecasting Model for Aquaculture Systems,
W83-03318 8I

DROUIN, M.
Backwater Curve Computations Under Ice Covers in the La Grande River (Courbes De Remous Sous Les Couverts De Glace De La Grande Riviere),
W83-03395 2C

DRURY, D. F.
Applications of a Serratia Marcescens Bacteriophage as a New Microbial Tracer of Aqueous Environments,
W83-03165 5B

DRUSE, S. A.
Verification of Step-Backwater Computations on Ephemeral Streams in Northeastern Wyoming,
W83-03366 2E

DUCKLOW, H. W.
Chesapeake Bay Nutrient and Plankton Dynamics. 1. Bacterial Biomass and Production During Spring Tidal Destratification in the York River, Virginia, Estuary,
W83-03264 2L

DUDEL, G.
The Influence of Sample Treatment on Nutrient Analysis in Eutrophic Waters (Der Einfluss Der Probenbehandlung Auf Die Nahrstoffanalytik Bei Eutrophen Gewassern),
W83-03392 5A

DUFFNER, R. M.
Water Quality of the Upper Spokane River and Evaluation of Methods for Measurement of the Effect of Effluent Upon Primary and Secondary Producers,
W83-03317 5A

DUGAN, G. L.
Water Quality of Airport Storm Runoff,
W83-03353 5B

DUMARS, C. T.
New Mexico Water Law: An Overview and Discussion of Current Issues,
W83-03492 6E

DURAKO, M. J.
Particulate Matter Resuspension Via Metabolically Produced Gas Bubbles From Benthic Estuarine Microalgae Communities,
W83-03261 2L

DUTRAM, P.
Monitoring of Groundwater Levels for Real-Time Conjunctive Water Management,
W83-03333 7B

DUZZIN, B.
Relationships Among the Bacteria Indicators of Fecal Pollution in the Water of the River Brenta (Relazioni Tra Gli Indicatori Di Inquinamento Fecale Nelle Acque Del Fiume Brenta)
W83-03485 5A

DYER, J. C.
Water Reuse and Recycling in the Textile Industry,
W83-03178 3E

EEDY, W.
The Evolution of Public Involvement in Reservoir Developments in Canada,
W83-03421 6G

EINHELLIG, F. A.
Efficiency of Water Use by Crops Under Allelopathy Stress,
W83-03313 2I

ELDER, J. F.
Production and Decomposition of Forest Litter Fall on the Apalachicola River Flood Plain, Florida,
W83-03364 5B

ELZEFTAWY, A.
Undisturbed Core Method for Determining and Evaluating the Hydraulic Conductivity of Unsaturated Sediments,
W83-03319 2G

ENG, G.
The Fate of Antifoulant Organotin Compounds in Water Systems,
W83-03315 5B

ERLANDSSON, B.
Studies of Activation Products in the Terrestrial Environments of Three Swedish Nuclear Power Stations,
W83-03397 5B

ERSTINE, J. M.
Expansion Potential for Irrigation Within the Mississippi Delta Region,
W83-03345 6B

ESOGBUE, A. O.
Quantitative Models and Analysis of Urban Nonpoint Source Water Pollution Control Systems,
W83-03184 6A

EVANS, L. S.
Effects of Simulated Acid Rain on Yields of Raphanus Sativus, Lactuca Sativa, Triticum Aestivum and Medicago Sativa,
W83-03195 5C

EVANS, T. E.
Modelling the Flood Alleviation Scheme for the Usk at Brecon,
W83-03247 8B

FAISON, J. H.
A Novel Bactericidal Agent for Treatment of Water,
W83-03337 5F

FAUST, S. D.
Buffer Capacities of Fresh Water Lakes Sensitive to Acid Rain Deposition,
W83-03171 2H

The Efficacy of Removal of Heavy Metals from Water by Calcite,
W83-03157 5F

Flood Control Effectiveness of Systems of Dual Purpose Detention Basins,
W83-03350 4A

FELDMANN, R. M.
Tufa Precipitation and its Effect on Drainage of Interstate Highways in Northeastern Ohio,
W83-03213 5B

FELLMANN, P.
Forecasting Methods in the Future Supply Area of the Rheintal Water Transmission Network (Beweissicherungsverfahren Im Kunftigen Wassergewinnungsgebiet Des Zweckverbands Fernwasserversorgung Rheintal (FWR),
W83-03456 3F

FILLER, J. R.
Hydrologic Flow Determination for Hydropower Feasibility Analysis,
W83-03271 2E

FLEMING, L. H.
Final Results of Testing of Abcor 8 Inches Spiral Wound Ultra-Filters at The Wrightsville Beach Test Facility,
W83-03288 3A

FORBES, L.
Plastic Tanks: Pitfalls to Avoid,
W83-03250 8G

FOSTER, P.
A Seasonal Study of the Distributions of Surface State Variables in Liverpool Bay. III. An Offshore Front,
W83-03173 2L

FRANK, M. D.
Irrigation Water Response Function Estimation: An Improved Ridge Regression Methodology,
W83-03302 6D

FRANK, R.
Aquatic Plant Control and Disappearance of Terbutryn from Treated Waters in Ontario, Canada, 1974-1977,
W83-03166 4A

FRANZ, J.
Topical Questions on Central Control and Monitoring for Water Supplies (Aktuelle Fragen Bei Zentraler Steuerung Und Uberwachung Von Wasserversorgungen),
W83-03449 5F

FRASCO, B. R.
The Role of Delaware River Freshwater Tidal Wetlands in the Retention of Nutrients and Heavy Metals,
W83-03169 2L

FRAZIER, L. B.
Development of a Cell Culture Screen for Water Toxicity,
W83-03306 5A

FRENCH, W. W.
Centrifugal Pump Basics,
W83-03258 8C

FRINK, D. L.
Water Storage Capacity of Natural Wetland Depressions in the Devils Lake Basin of North Dakota,
W83-03160 2H

FRITTON, D. D.
On-Site Sewage Disposal: Site Suitability, System Selection and Soil Absorption Area Sizing,
W83-03268 5D

FUCHS, H. V.
Promising Experiments on Leak Location by Means of Correlation (Aussichtsreiche Versuche Zur Leckortung Mittels Korrelation),
W83-03445 5F

FUJIOKA, R. S.
Effect of Sunlight on Enumeration of Indicator Bacteria Under Field Conditions,
W83-03291 5A

FUKSA, J.
Diel Changes in Numbers and Activities of Bacterioplankton in a Reservoir in Relation to Algal Production,
W83-03263 2H

FULLERTON, C. M.
Rainfall Cell Size From Rit Curve Analysis,
W83-03339 2B

FUNK, W. H.
Water Quality of the Upper Spokane River and Evaluation of Methods for Measurement of the Effect of Effluent Upon Primary and Secondary Producers,
W83-03317 5A

FYTIANOS, K.
Heavy Metals in Flowing Waters and River Sediments of the Western Harz Region (Schwermetalle in Den Fliessgewassern Und Flusssedimenten Des West-Harzes,
W83-03457 5B

GALANIN, P. I.
Reuse of Treated Municipal Wastewater in the Technical Supply of Industrial Companies in Moscow (Die Wiederverwendung Des Gereinigten Kommunalen Abwasser In Der Technischen Wasserversorgung Der Moskauer Industriebetriebe),
W83-03222 5D

GARAY, E.
Improved Salmonella Recovery from Moderate to Highly Polluted Waters,
W83-03164 5A

GARTON, J. E.
Irrigation Water Conservation by Using Wide-Spaced Furrows,
W83-03408 3F

GEISENHEINER, A.
Problems of the Load at Veb Zellstoff-Und Papierfabrik Rosenthal (Probleme Der Abwasserlast Im Veb Zellstoff-Und Papierfabrik Rosenthal),
W83-03223 5D

GERLACH, U.
Inverse-Voltammetry of Some Copper Chelates Using a Carbon Paste Electrode. Determination of Copper in Drinking Water by Oxidation of Copper Dithio-Oxamide (Zur Invers-Voltammetrie Einiger Kupferchelate an Der Kohlepaste-Electrode. Bestimmung Von Kupfer in Trinkwasser Durch Oxidation Von Kupferdithiooxamid),
W83-03415 5A

GETSINGER, K. D.
Investigation Into Effective Control Methods for Brazilian Elodea (Egeria Densa Planchon) in Lake Marion, S.C.,
W83-03433 4A

GIBBONS, H. L.
Water Quality of the Upper Spokane River and Evaluation of Methods for Measurement of the Effect of Effluent Upon Primary and Secondary Producers,
W83-03317 5A

GIBBS, M. T.
The Escatawpa River - An Interstate Approach to Water Resource Management,
W83-03354 6E

GIBLIN, A.
Pyrite and Oxidized Iron Mineral Phases Formed from Pyrite Oxidation in Salt Marsh and Estuarine Sediments,
W83-03451 2L

GIFFORD, G. F.
Fecal Coliform Release Studies and Development of a Preliminary Nonpoint Source Transport Model for Indicator Bacteria,
W83-03376 5B

GIGGENBACH, W. F.
'Geothermal Mineral Equilibria.' Reply to a Comment by M. A. Grant,
W83-03416 2K

GILES, I. S.
Radioelements, Radiogenic Helium and Age Relationships for Groundwaters From the Granites at Stripa, Sweden,
W83-03208 2F

GILLESPIE, D. M.
Production of Invertebrates in the Tidewater Zone of a Coastal River and Adjacent Estuary,
W83-03183 2L

GILLEY, J. R.
Water and Energy Conservation Using Center Pivot Irrigation and Reduced Tillage Systems,
W83-03342 3F

GIOVANARDI, A.
Drinking Water Contamination with Chloro-Organic Compounds: Sources, Health Effects, Control (Contaminazione Delle Acque Potabili Da Composti Cloro-Organici: Origine, Effetti Biologici, Misure Di Protezione E Di Controllo),
W83-03476 5F

GLEISBERG, D.
Effect of Precipitation Purification on the Behavior of Sludges During Mechanical Dewatering (Einfluss Der Fallungsreinigung Auf Das Verhalten Von Klarschlammen Bei Der Mechanischen Entwasserung),
W83-03444 5D

GMUR, N. F.
Effects of Simulated Acid Rain on Yields of Raphanus Sativus, Lactuca Sativa, Triticum Aestivum and Medicago Sativa,
W83-03195 5C

GOETSCH, W. D.
Efficient Use of Water for Irrigation in the Upper Midwest,
W83-03282 6D

GOLWER, A.
Organic Matter Pollution of Groundwater Near Highways (Belastung Des Grundwassers Mit Organischen Stoffen Im Gebiet Von Strassen),
W83-03446 5B

GOOD, R. E.
The Role of Delaware River Freshwater Tidal Wetlands in the Retention of Nutrients and Heavy Metals,
W83-03169 2L

GOSHOVSKAYA, G. A.
Hydrobiology of the Littoral Zone of the Dnieper Estuary Under Conditions of Regulated Flow of the River,
W83-03480 6G

GOSSE, G.
Field Study of Actual Evapotranspiration of a Wheat Crop (Etude 'In Situ' De L'Evapotranspiration Reelle D'une Culture De Ble),
W83-03389 2D

GOULD, J. P.
Identification and Assessment of Effluent Residuals in Treated Leachate from Landfill Disposal Sites,
W83-03272 5E

GRAETZ, D. A.
Effect of Aquatic Macrophytes on Physico-Chemical Parameters of Agricultural Drainage Water,
W83-03153 5G

GRANT, M. A.
On the Lack of a Unique Relation Between C02 Partial Pressure and Temperature in Geothermal System. Comment on 'Geothermal Mineral Equilibria' by W. F. Giggenbach,
W83-03434 2K

GRASHCHENKO, V. M.
Use of Polyethylene Imines in Flotation and Improving the Filtration of Suspensions of Blue-Green Algae,
W83-03471 5F

GRILLO, O. C.
Viral Contamination of Seawater at Messina (Inquinamento Di Natura Virale Delle Acque Di Mare Della Citta'Di Messina),
W83-03484 5B

GUILBOT, A.
Study of the Changes in River Water Quality (Etude De L'Evolution De La Qualite Des Eaux De Riviere),
W83-03267 5B

GUNDERLACH, V. G.
Monitoring Flocculation in Water Treatment Using a Computer-Controlled Physical Model (Uberwachung der Wasseraufbereitung Mit Hilfe Eines Rechnergesteuerten Physikalischen Modells),
W83-03439 5F

HADJIANGHELOU, H.
A Method for Calculating the Dimensions of Long Sewage Force Mains,
W83-03199 5D

HALL, J. F.
Threshold 2,4-D Concentrations for Control of Eurasian Watermilfoil and Sago Pondweed,
W83-03163 4A

HALL, M. S.
Development of a Cell Culture Screen for Water Toxicity,
W83-03306 5A

HALL, R. B.
Automated Strain Gage Dendrography for Improved Water Utilization in Plants,
W83-03372 2I

HALL, T. M.
Free Ionic Nickel Accumulation and Localization in the Freshwater Zooplankter, Daphnia Magna,
W83-03256 5B

HALL, W. A.
Technology Assessment of Irrigation Scheduling and Crop Response,
W83-03488 3F

HAMILTON, L. C.
The Concord Water Survey,
W83-03351 3D

HAMPEL, W.
Development and Status of Emergency Drinking Water Supply in the Federal Republic of Germany After Passage of the Water Safeguarding Law (Entwicklung und Stand Der Tinkwasser-Notversorgung in Der Bundesrepublik Nach Dem Wassersicherstellungsgesetz),
W83-03458 5F

HANNA, J. E.
Fisheries Productivity and Water Level Fluctuations in Lac Seul, Northwestern Ontario,
W83-03212 6G

HARLEY, M. J.
Water Industry Accountability Through the Ombudsman System,
W83-03233 6E

HARPER, L. A.
Basin-Scale Evapotranspiration Determination through Watershed and Climate Analyses,
W83-03328 2D

HARRIS, T. R.
The Impact of Institutional Structure and Citizen Participation on Water Resource Planning in Western Kansas,
W83-03330 6D

HARRISON, A. T.
Measurement of Actual Transpiration of Native Grass Stands as a Component of Nebraska Sandhills Groundwater Hydrology,
W83-03312 2D

HARTE, J.
The Potential for Acid Precipitation Damage to Lakes of the Sierra Nevada, California,
W83-03182 5B

HARTMANN, H. J.
Control of Algal Dominance Through Changes in Zooplankton Grazing, Lake Washington: Phase I,
W83-03467 5G

HASSAN, A. A.
Methodologies for Extraction of Dissolved Inorganic Carbon for Stable Carbon Isotope Studies: Evaluation and Alternatives,
W83-03359 2K

HEAVENER, C. M.
The Start-up and Testing of a 6,000 GPD Indirect Freeze Desalination Pilot Plant,
W83-03468 3A

HEGEMANN, W.
Automation in Wastewater Technology and Water Quality. Practical Experience with Control, Regulation, and Automation in Sewer Systems, Wastewater Treatment, and Water Quality Control (Automation in Der Abwassertechnik und Gewassergute. Praktische Erfahrungen Bei Der Steuerung, Regelung und Automation Bei Der Abwasserableitung, Abwasserbehandlung und Gewasserguteuberwachung,
W83-03469 5D

HEIST, J. A.
Organic Absorbents for Triple Point Absorption Freeze Crystallization Processes,
W83-03341 3A

HEITZMAN, G. C.
Hydraulic Analysis of Surcharged Storm Sewer Systems,
W83-03374 8B

HELZ, G. R.
Composition of Estuarine Colloidal Material: Organic Components,
W83-03202 2L

HENRY, C. D.
Trans-Boundary Geothermal Resources of Texas and Mexico,
W83-03499 2F

HERRINGTON, B. E. JR.
Expansion Potential for Irrigation Within the Mississippi Delta Region,
W83-03345 6B

HERSON, D. S.
New Approaches to Measuring Total Bacterial Populations in Water Supplies,
W83-03292 5A

HESS, A. L.
Radon-222 in Potable Water Supplies in Maine: The Geology, Hydrology, Physics and Health Effects,
W83-03308 2K

HESS, C. T.
Radon-222 in Potable Water Supplies in Maine: The Geology, Hydrology, Physics and Health Effects,
W83-03308 2K

HOBSON, M.
Water Industry Accountability Through the Ombudsman System,
W83-03233 6E

HOCHREITER, J. J. JR.
Chemical-Quality Reconnaissance of the Water and Surficial Bed Material in the Delaware River Estuary and Adjacent New Jersey Tributaries, 1980-81,
W83-03363 2L

HODGES, J. C. JR.
Production of Invertebrates in the Tidewater Zone of a Coastal River and Adjacent Estuary,
W83-03183 2L

HOERING, T. C.
Composition of Estuarine Colloidal Material: Organic Components,
W83-03202 2L

HOLDREN, J.
The Potential for Acid Precipitation Damage to Lakes of the Sierra Nevada, California,
W83-03182 5B

HOLLAND, T. W.
Use of Water in Arkansas, 1980,
W83-03367 6D

HOOVER, J. J.
The Biota of Oklahoma Springs: Natural Biological Monitoring of Groundwater Quality,
W83-03347 2H

HOWARTH, R. W.
Pyrite and Oxidized Iron Mineral Phases Formed from Pyrite Oxidation in Salt Marsh and Estuarine Sediments,
W83-03451 2L

HOWES, H.
The Evolution of Public Involvement in Reservoir Developments in Canada,
W83-03421 6G

HOXIT, L. R.
Johnstown-Western Pennsylvania Storm and Floods of July 19-20, 1977,
W83-03357 2E

HUGHES, W. B.
Ground Water Quantity and Quality in Fracture Zones in Abbeville County, South Carolina,
W83-03466 3B

HULL, R. J.
Recovery and Transport of Heavy Metals by Spartina Alterniflora From Dredging Spoils,
W83-03381 2L

HUNTER, J. V.
Influence of Land Utilization on Hydrocarbon Runoff Pollution,
W83-03156 5B

HUSSAIN, Z.
Problems of Irrigated Agriculture in Al-Hassa, Saudi Arabia,
W83-03391 3C

HWANG, W-J.
Deuterium as a Tracer in the Groundwater Study of a Central North Dakota Mining Area,
W83-03177 5A

IMHOFF, K. R.
Nutrient Contents and Algal Growth in an Impounded River: Effects on Oxygen Balance and need for Nutrient Retention (Nahrstoffgehalte und Algenwachstum in Einem Gestauten Fluss, Auswirkungen Auf Die Sauerstoffbilanz Und Notwendigkeit Des Nahrstoffruckhaltes),
W83-03454 5C

INGEMANSSON, T.
Studies of Activation Products in the Terrestrial Environments of Three Swedish Nuclear Power Stations,
W83-03397 5B

INGLIS, M.
Landsat Monitoring of Irrigated Farmland Acreage in Curry County, New Mexico,
W83-03310 7A

ITIER, B.
Field Study of Actual Evapotranspiration of a Wheat Crop (Etude 'In Situ' De L'Evapotranspiration Reelle D'une Culture De Ble),
W83-03389 2D

IVANOVA, L. S.
Tendencies in the Changes in the Saprobic Conditions of the Maritsa River (Tendentsii V Izmenenyata Na Saprobiolodgichnoto Sustoyanie Na Reka Maritsa),
W83-03473 5C

JACKSON, W. T.
The Evolution of California State Water Planning 1850-1928,
W83-03274 6E

JACOBSON, R. L.
Environmental Isotopic and Hydrogeochemical Investigation of Recharge and Subsurface Flow in Eagle Valley, Nevada,
W83-03380 2F

JAMES, L. D.
Index Construction for Multiple Objective Analysis of Land and Water Use in a High Mountain Watershed,
W83-03286 6A

JENSEN, R. G.
Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho--Emphasis: 1974-1978,
W83-03365 5B

JOHNSON, C. W.
Texas Groundwater Law: A Survey and Some Proposals,
W83-03497 6E

JOHNSON, D. B.
Automated Strain Gage Dendrography for Improved Water Utilization in Plants,
W83-03372 2I

JOHNSON, D. H.
Water Storage Capacity of Natural Wetland Depressions in the Devils Lake Basin of North Dakota,
W83-03160 2H

JOHNSON, E. B.
A Public Participation Decision to Fill a Pacific Northwest Reservoir,
W83-03423 6D

JOHNSON, W. C.
The Effects of Altered Hydrologic Regime on Tree Growth Along the Missouri River in North Dakota,
W83-03262 6G

JOLLANS, W. M.
Fit to Drink,
W83-03236 5F

JONES, J. R.
A Survey of Water Transparency in Iowa Lakes,
W83-03371 5C

JONES, R. A.
Assessing Enviromental Impacts of Open Water Disposal of Dredged Sediment,
W83-03251 6G

JONES, S. D.
Determination of Total Iodine and Iodate-Iodine in Natural Freshwater,
W83-03206 5A

JORDENS, H. E.
Valves, Penstocks and Actuators: Reliable Control of Water Systems,
W83-03245 5F

JUDKINS, J. F. JR.
Water Reuse and Recycling in the Textile Industry,
W83-03178 3E

JUSTUS, C. G.
Comparative Study of the Causes and Effects of Recent Southeastern Droughts,
W83-03297 2B

KAFRI, U.
Effects of Groundwater Pumpage on Surface and Groundwater Flows on Adjoining Basins,
W83-03431 4B

KALBSKOPF, K. H.
Anaerobic Activated Sludge Treatment of Filtrates From Thermally Conditioned Sludges (Die Behandling Von Filtratwassern Thermisch Konditionierter Schlamme Nach Anaeroben Belebunsverfahren),
W83-03440 5D

KAPALOSKI, L.
Adapting Appropriation Water Law to Accommodate Equitable Consideration of Instream Flow Uses,
W83-03379 6E

KASHNER, J.
Influence of Land Utilization on Hydrocarbon Runoff Pollution,
W83-03156 5B

KATERJI, N.
Field Study of Actual Evapotranspiration of a Wheat Crop (Etude 'In Situ' De L'Evapotranspiration Reelle D'une Culture De Ble),
W83-03389 2D

KAWADA, K.
Fluorimetric Determination of Chloroform in Drinking Water,
W83-03190 5A

KAY, R. L. F.
Radioelements, Radiogenic Helium and Age Relationships for Groundwaters From the Granites at Stripa, Sweden,
W83-03208 2F

KELLER, E. A.
Large Organic Debris and Anadromous Fish Habitat in the Coastal Redwood Environment: The Hydrologic System,
W83-03335 2E

KENDALL, V.
Hydrology of Area 14, Eastern Coal Province, Kentucky,
W83-03355 7C

KERAMBRUN, P.
Changes in Esterase Zymograms of a Planktonic Copepod, Acartia Clausi, in a Polluted Marine Area (Sewage Output of Marseilles) (Modifications Des Zymogrammes Des Esterases D'Un Copepode Planctonique, Acartia Clausi Dans Une Emissaire De Marseille),
W83-03386 5C

KETTLE, W. D.
The Responses of Plankton Communities in Experimental Ponds to Atrazine, the Most Heavily Used Pesticide in the United States,
W83-03255 5C

KHOMINSKAYA, N. V.
Use of Polyethylene Imines in Flotation and Improving the Filtration of Suspensions of Blue-Green Algae,
W83-03471 5F

KIELL, D. J.
Development of a Reservoir Preparation Strategy,
W83-03420 6G

KING, C. M.
Radioactivity in Water from the River Lea,
W83-03401 5A

KING, L. G.
Surface Irrigation as Affected by Ash from Mount St. Helens,
W83-03285 2J

KITANIDIS, P. K.
Real-Time Forecasting of River Flows and Stochastic Optimal Control of Multireservoir Systems,
W83-03323 4A

KLEINSCHROTH, A.
Inlet Construction for Vortex Drops With Supercritical Inflow (Einlaufkonstruktion Fur Wirbelfallschachte Mit Schiessendem Zufluss),
W83-03481 8B

KLINZMANN, G.
Biological Wastewater Purification with Technical Oxygen (Biologische Abwasserreinigung Mit Techn. Reinem Sauerstoff),
W83-03443 5D

KLONTZ, G. W.
Aquaculture Techniques: A Production Forecasting Model for Aquaculture Systems,
W83-03318 8I

KOBUS, H.
Hydraulic Criteria for the Design of Weir Sills (Hydraulische Entwurfs- Und Bemessungskriterien fur Sohlschwellen),
W83-03241 8B

KOCH, R. W.
Regional Detection of Change in Water Quality Variables,
W83-03295 2A

KOENIG, P. G.
A Computer Model for Predicting the Impact of Irrigating with Saline Water on Soils and Runoff Water in Missouri,
W83-03284 3C

KOHL, H. H.
A Novel Bactericidal Agent for Treatment of Water,
W83-03337 5F

KOHL, J. G.
The Influence of Sample Treatment on Nutrient Analysis in Eutrophic Waters (Der Einfluss Der Probenbehandlung Auf Die Nahrstoffanalytik Bei Eutrophen Gewassern),
W83-03392 5A

KOLBERG, D. W.
Basin-Scale Evapotranspiration Determination through Watershed and Climate Analyses,
W83-03328 2D

KOPLITZ-WEISSGERBER, G.
Inlet Construction for Vortex Drops With Supercritical Inflow (Einlaufkonstruktion Fur Wirbelfallschachte Mit Schiessendem Zufluss),
W83-03481 8B

KORTE, F.
Photoinduced Hydroxylation Reactions of Organic Chemicals in Natural Waters, Nitrates as Potential OH Radical Sources (Photoinduzierte Hydroxylierungsreaktionen Organischer Chemikalien in Naturlichen Gewassern, Nitrate Als Potentielle Oh-Radikalquellen),
W83-03385 5B

KOTZIAS, D.
Photoinduced Hydroxylation Reactions of Organic Chemicals in Natural Waters, Nitrates as Potential OH Radical Sources (Photoinduzierte Hydroxylierungsreaktionen Organischer Chemikalien in Naturlichen Gewassern, Nitrate Als Potentielle Oh-Radikalquellen),
W83-03385 5B

KOVACHEV, S. G.
Species Composition and Distribution of the Macrozoobenthos of the Maritsa River (Vidov Sustav I Razpredelenie Na Makrozoobentosa Ot Reka Maritsa),
W83-03474 5C

The Species Deficit of the Macrozoobenthic Communities as a Criterion for the Transsaprobic Influences on the Maritsa River (Vidoviyat Defitsit Na Makrozoobentosnite Suobshchestva Kato Kriterii Za Transsaprobnite Vliyaniya Vurkhu Reka Maritsa),
W83-03475 5C

Tendencies in the Changes in the Saprobic Conditions of the Maritsa River (Tendentsii V Izmenenyata Na Saprobiolodgichnoto Sustoyanie Na Reka Maritsa),
W83-03473 5C

KRESS, M.
Fecal Coliform Release Studies and Development of a Preliminary Nonpoint Source Transport Model for Indicator Bacteria,
W83-03376 5B

KUHN, W.
Groundwater Purification by Infiltration of Ozonized Water (Grundwassersanierung Durch Infiltration Von Ozontem Wasser),
W83-03200 5G

LAFLEN, J. M.
Effect of Incorporation of Fall-Applied Fertilizer on Runoff Losses of Nutrients and Soil From Soybean Ground,
W83-03298 2J

LAFORD, T. J.
Removal of Nitrate, Sulfate and Hardness from Groundwater by Ion Exchange,
W83-03290 5F

LAMARRA, V. A.
An Experimental Investigation of the Effects of Crude Oil on Two Freshwater Lake Ecosystems,
W83-03273 5C

LARSON, D. T.
Adapting Appropriation Water Law to Accommodate Equitable Consideration of Instream Flow Uses,
W83-03379 6E

Index Construction for Multiple Objective Analysis of Land and Water Use in a High Mountain Watershed,
W83-03286 6A

LARSON, D. W.
Comparison of Reservoirs with Dissimilar Selective Withdrawal Capabilities: Effects on Reservoir Limnology and Release Water Quality,
W83-03422 5G

LASKE, C.
Promising Experiments on Leak Location by Means of Correlation (Aussichtsreiche Versuche Zur Leckortung Mittels Korrelation),
W83-03445 5F

LAUFER, H.
The Effect of Hormonal Pollutants on Aquatic Crustacea and the Surrounding Environment,
W83-03314 5C

LEACH, F. R.
Development of a Cell Culture Screen for Water Toxicity,
W83-03306 5A

LEATHERBERRY, E. C
A Test for Inequity in River Recreation Reservation Systems,
W83-03175 6D

LEE, D. J.
Radioelements, Radiogenic Helium and Age Relationships for Groundwaters From the Granites at Stripa, Sweden,
W83-03208 2F

LEE, G. F.
Assessing Enviromental Impacts of Open Water Disposal of Dredged Sediment,
W83-03251 6G

LEE, K.-B.
Water and Sewer System Modelling Using a Micro-Computer System,
W83-03243 5F

LEHMAN, O. R.
The Extent and Nature of Rainfall-Soil Interaction in the Release of Soluble Chemicals to Runoff,
W83-03170 5B

LEITCH, J. A.
An Economic Analysis of the Devils Lake Basin and Proposed Land Use,
W83-03270 6B

LESCURE, J. P.
Use of Anaerobic Digestion in the Agricultural and Food Industries (Application De La Degestion Anaerobie Dans Les Industries Agro-Alimentaires),
W83-03252 5D

LEWIS, B. D.
Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho--Emphasis: 1974-1978,
W83-03365 5B

LIBERTI, L.
Advanced Wastewater Treatment by Ion Exchange,
W83-03196 5D

LILLEY, D. G.
Computer Simulation of Local Destratification in Reservoirs,
W83-03279 5G

LINTAS, M. L.
Physical, Chemical, and Biological Characteristics of Lake Omodeo, Part II: Possibility of Using Impounded Water for Supplying Oristano City (Fenomeni Biologici Di Un Lago Artificiale Di Antica Data: Lago Omodeo, Nota II: Sulla Possibilita Di Utilizzare Le Acque Dell'Invaso Per La Alimentazione Idrica Della Citta Di Oristano),
W83-03477 5F

LLOYD, B. J.
The Removal of Salmonella Enteritidis in Activated Sludge,
W83-03152 5D

LLOYD, S. W.
Effects of Simazine Treatment on Channel Catfish Production and Water Quality in Ponds,
W83-03167 5G

LOEHR, R. C.
Priority Pollutants in Municipal Sewage Sludge, Part II,
W83-03406 5E

LOMAX, W. R.
The Construction and Operation of an Articulated Laboratory Flow Channel,
W83-03230 8B

LONG, D. A.
On-Site Sewage Disposal: Site Suitability, System Selection and Soil Absorption Area Sizing,
W83-03268 5D

LU, Z. -X.
Management of Human Excreta,
W83-03191 5D

LUCE, H. D.
The Movement of Nitrates, Phosphates, and Fecal Coliform Bacteria From Disposal Systems Installed in Selected Connecticut Soils,
W83-03276 5B

LUDDEN, A. P.
Water Storage Capacity of Natural Wetland Depressions in the Devils Lake Basin of North Dakota,
W83-03160 2H

LUDWIG, A. H.
Use of Water in Arkansas, 1980,
W83-03367 6D

LUND, S. W.
Soil Conservation and the Reduction of Erosion and Sedimentation in the Coon Creek Basin, Wisconsin,
W83-03356 4D

LUSK, M.
Post-Mining Neutralization of Acidic Surface Mine Lakes,
W83-03278 5B

LUTHER, G. W. III
Pyrite and Oxidized Iron Mineral Phases Formed from Pyrite Oxidation in Salt Marsh and Estuarine Sediments,
W83-03451 2L

LYNCH, T. R.
An Evaluation of Sediments in the Middle Rio Grande, Elephant Butte Reservoir, and Caballo Reservoir as Potential Sources for Toxic Meterials,
W83-03322 5B

MACDONALD, A.
Large Organic Debris and Anadromous Fish Habitat in the Coastal Redwood Environment: The Hydrologic System,
W83-03335 2E

MACINTYRE, S.
Meromixis in an Equatorial African Soda Lake,
W83-03254 2H

MACKENZIE, D.
Aquatic Plant Control and Disappearance of Terbutryn from Treated Waters in Ontario, Canada, 1974-1977,
W83-03166 4A

MADDOX, R. A.
Johnstown-Western Pennsylvania Storm and Floods of July 19-20, 1977,
W83-03357 2E

MALCOLM, K.
California Groundwater Management: The Sacred and the Profane,
W83-03498 6E

MALE, J. W.
The Flood Mitigation Potential of Inland Wetlands,
W83-03349 6A

MALINOVSKAYA, L. A.
Trace Elements (Manganese, Zinc and Copper) in the USSR Part of the Danube River,
W83-03470 5B

MANCINI, D.
Effects of Simulated Acid Rain on Yields of Raphanus Sativus, Lactuca Sativa, Triticum Aestivum and Medicago Sativa,
W83-03195 5C

MANDON, C.
Determination of PAH in Water and Sediments by Low Temperature Fluorimetry (Dosage Des Hydrocarbures Aromatiques Polynucleaires Dan Les Eaux Et Les Sediments Par Fluorimetrie A Basse Temperature),
W83-03413 5A

MARDIROSSIAN, Z.
How Pulsators and Superpulsators Can Improve the Water Treatment Process,
W83-03220 5F

MARECHAL, A.
Polarographic Determination of Low Levels of Cyanide and Metals in the Waste-Waters Discharged by an Electroplating Plant (Dosages Polarographiques de Faibles Quantities D'Ions Cyanure et de Metaux Dans Les Euax Rejetees Par un Atelier de Galvanoplastie),
W83-03412 5A

MARIN, V.
Relationships Among the Bacteria Indicators of Fecal Pollution in the Water of the River Brenta (Relazioni Tra Gli Indicatori Di Inquinamento Fecale Nelle Acque Del Fiume Brenta)
W83-03485 5A

MARRO, C. A.
Agricultural Irrigation Technology Transfer Assessment,
W83-03281 3F

MARTIN, E. L.
The Biological Regulation of Bloom-Causing Blue-Green Algae: A Feasible Alternative,
W83-03311 5C

MARTINEZ-GERMES, P.
Improved Salmonella Recovery from Moderate to Highly Polluted Waters,
W83-03164 5A

MARTINEZ, J. P.
Improved Salmonella Recovery from Moderate to Highly Polluted Waters,
W83-03164 5A

MATTHEWS, W. J.
The Biota of Oklahoma Springs: Natural Biological Monitoring of Groundwater Quality,
W83-03347 2H

MATTSSON, S.
Studies of Activation Products in the Terrestrial Environments of Three Swedish Nuclear Power Stations,
W83-03397 5B

MATTYUS, S.
Possibility of Reducing Energy Costs for Water Conveyance Using a Preliminary Reservoir (Einsparmoglichkeit an Energiekosten Zur Wasserforderung Durch Einsatz Eines Vorbehalters),
W83-03459 8A

MAY, R. D.
Expansion Potential for Irrigation Within the Mississippi Delta Region,
W83-03345 6B

MAY, S.
Parametric Study of Seawater Reverse Osmosis Desalting Plants,
W83-03316 3A

MAYER, E.
Vitrification of Pure Liquid Water by High Pressure Jet Freezing,
W83-03259 1A

MAYER, L. M.
Aggregation of Collodial Iron During Estuarine Mixing: Kinetics, Mechanism, and Seasonality,
W83-03450 2L

MAZUR, V.
Monitoring of Groundwater Levels for Real-Time Conjunctive Water Management,
W83-03333 7B

MCCARTHY, J. J.
The Uptake of Dissolved Nitrogenous Nutrients by Lake Kinneret (Israel) Microplankton,
W83-03260 2H

MCCARTY, P. L.
Removal of Trace Chlorinated Organic Compounds by Activated Carbon and Fixed-Film Bacteria,
W83-03194 5D

MCDONALD, B.
Water Availability in the New Mexico Upper Rio Grande Basin to the Year 2000,
W83-03493 6D

MCINTOSH, A.
Buffer Capacities of Fresh Water Lakes Sensitive to Acid Rain Deposition,
W83-03171 2H

MCKEE, M.
Index Construction for Multiple Objective Analysis of Land and Water Use in a High Mountain Watershed,
W83-03286 6A

MCLENNAN, R.
Effects of Silvicultural Practices on Water Quality in Northern Wisconsin,
W83-03304 5G

MCQUEEN, A. D.
The Costs and Benefits of Soil Erosion Control in the North Lake Chicot Watershed,
W83-03331 4D

MEDLYN, R. A.
Particulate Matter Resuspension Via Metabolically Produced Gas Bubbles From Benthic Estuarine Microalgae Communities,
W83-03261 2L

MEIER, M. F.
Calving Speed of Alaska Tidewater Glaciers, With Application to Columbia Glacier,
W83-03358 2C

MELACK, J. M.
Meromixis in an Equatorial African Soda Lake,
W83-03254 2H

MENZEL, R. G.
Evaluating the Release of Soluble Components from Sediment,
W83-03168 5B

MERCER, J. W.
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-5A, H-5B, and H-5C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03360 2K

MERKEL, W.
The Meaning of the Generally Accepted Technological Standards for the Planning, Construction, and Operation of Water Distribution Facilities (Die Bedeutung Der Anerkannten Regeln Der Technik Fur Planung, Bau und Betrieb Von Wasserversorgungsanlagen),
W83-03441 6E

MERKS, A. G. A.
The Influence of Micro-Algae on the Oxygen Dynamics in a Brackish Ditch,
W83-03215 5C

Saline Seepage and Vertical Distribution of Oxygen in a Brackish Ditch,
W83-03216 5C

MERMIER, M.
The Use of Industrial Waste Water. I. Aerial and Soil Microclimatic Modifications Due to Heating by Wastewater (20 Degrees C) Circulating in Buried Pipes (Utilisation Des Eaus De Rejet En Agriculture, I. Modifications Microclimatiques Dues Au Chauffage Du Sol Par Tuyaux Enterres, En Plein Champ)
W83-03388 3C

MESSER, J. J.
Index Construction for Multiple Objective Analysis of Land and Water Use in a High Mountain Watershed,
W83-03286 6A

MICHALSKI, M. F. P.
Fisheries Productivity and Water Level Fluctuations in Lac Seul, Northwestern Ontario,
W83-03212 6G

Multiple Use Reservoir Planning Approaches: Lac Seul, Northwestern Ontario,
W83-03211 6A

MICHEL, B.
Backwater Curve Computations Under Ice Covers in the La Grande River (Courbes De Remous Sous Les Couverts De Glace De La Grande Riviere),
W83-03395 2C

MIDDLETON, D. L.
Tufa Precipitation and its Effect on Drainage of Interstate Highways in Northeastern Ohio,
W83-03213 5B

MIELKE, L. N.
Water and Energy Conservation Using Center Pivot Irrigation and Reduced Tillage Systems,
W83-03342 3F

MIKUS, K.
Energy Reclamation from the Drinking Water System with Series-Connected Pumps (Energieruckgewinnung Aus Dem Trinkwassersystem Mit Serienpumpen),
W83-03460 8C

MILES, L. C.
Current Stormwater Drainage Practice in South Africa,
W83-03387 4A

MILLER, I.
A Seasonal Study of the Distributions of Surface State Variables in Liverpool Bay. III. An Offshore Front,
W83-03173 2L

MILLER, R. F.
Effects of Increased Precipitation and Grazing Management on Northeastern Montana Rangelands,
W83-03174 4D

MILSTEAD, W. B.
The Biota of Oklahoma Springs: Natural Biological Monitoring of Groundwater Quality,
W83-03347 2H

MITCHELL, W. R.
Biodegradation of 1,3-Dinitrobenzene,
W83-03155 5B

MODEL, J.
Improved Formulas for Estimating Groundwater Supplies by Short-Term Precipitation-Minimum Series (Verbesserte Ansatza Fuer Die Schatzung Der Dargebote Von Grundwassermengen Durch Niederschlags-Minimum-Kurzreihen),
W83-03461 2A

MOFFLER, M. D.
Particulate Matter Resuspension Via Metabolically Produced Gas Bubbles From Benthic Estuarine Microalgae Communities,
W83-03261 2L

MONIEN, H.
Inverse-Voltammetry of Some Copper Chelates Using a Carbon Paste Electrode. Determination of Copper in Drinking Water by Oxidation of Copper Dithio-Oxamide (Zur Invers-Voltammetrie Einiger Kupferchelate an Der Kohlepaste-Electrode. Bestimmung Von Kupfer in Trinkwasser Durch Oxidation Von Kupferdithiooxamid),
W83-03415 5A

MOREL-SEYTOUX, H. J.
Regional Detection of Change in Water Quality Variables,
W83-03295 2A

MORGENSCHWEIS, G.
On The Esimation of the Error of Soil Moisture Measurement by Means of a Neutron Scattering Probe (Zur Abschatzung Des Fehlers Der Bodenfeuchte-Messung Mit Einer Neutronensonde),
W83-03242 7B

MORTON, R. A.
Trans-Boundary Geothermal Resources of Texas and Mexico,
W83-03499 2F

MUIR, J. F.
An Evaluation of Proposed Cage Fish Culture on Loch Lomond, An Important Reservoir in Central Scotland,
W83-03403 6G

MULL, D. S.
Hydrology of Area 14, Eastern Coal Province, Kentucky,
W83-03355 7C

MULLER, P.
Hydraulic Criteria for the Design of Weir Sills (Hydraulische Entwurfs- Und Bemessungskriterien fur Sohlschwellen),
W83-03241 8B

MULLINS, G. L.
Chemical Speciation of Leachates From Waste Disposal Sites,
W83-03432 5B

MUNAO, F.
Viral Contamination of Seawater at Messina (Inquinamento Di Natura Virale Delle Acque Di Mare Della Citta'Di Messina),
W83-03484 5B

MURALI, M. M.
Trihalomethane Removal and Formation Mechanism in Water,
W83-03430 5F

MUSTERMAN, J. L.
Removal of Nitrate, Sulfate and Hardness from Groundwater by Ion Exchange,
W83-03290 5F

NAGEL, G.
Groundwater Purification by Infiltration of Ozonized Water (Grundwassersanierung Durch Infiltration Von Ozontem Wasser),
W83-03200 5G

NAKHSHINA, Y. P.
Trace Elements (Manganese, Zinc and Copper) in the USSR Part of the Danube River,
W83-03470 5B

NARIKAWA, O. T.
Effect of Sunlight on Enumeration of Indicator Bacteria Under Field Conditions,
W83-03291 5A

NATARAJAN, P.
Trihalomethane Removal and Formation Mechanism in Water,
W83-03430 5F

NAYLOR, L. M.
Priority Pollutants in Municipal Sewage Sludge, Part II,
W83-03406 5E

NAZAROV, I. I.
Main Results of Investigating Siltation of the Reservoir of the Tereblya-Rika Hyroelectric Station,
W83-03204 2J

NECHAMEN, W.
Flood Loss Reduction Through Interstate Compacts: An Under-Utilized Approach,
W83-03324 6F

NEGRON, E.
A Study of Eutrophication and Aquatic Plants Growths in Selected Lakes and Rivers of Puerto Rico,
W83-03300 5C

NEUMANN, W.
Model Rainfall for Sewer System Design Current Knowledge and Recommendations (Modellregren Zur Kanalnetzbemessung - Kenntnisstand Und Empfehlungen),
W83-03453 2A

Obtaining Rainfall Intensity Curves from Munich Rainfall Records (Die Ermittlung Von Regenspendelinien Aus Munchner Regenschreiberaufzeichnungen),
W83-03452 2B

NICKLISCH, A.
The Influence of Sample Treatment on Nutrient Analysis in Eutrophic Waters (Der Einfluss Der Probenbehandlung Auf Die Nahrstoffanalytik Bei Eutrophen Gewassern),
W83-03392 5A

NIEBER, J. L.
Assessment of Stormflow and Water Quality From Undisturbed and Site Prepared Forest Land in East Texas,
W83-03277 4C

NIELSEN, T.
Water Quality of the Upper Spokane River and Evaluation of Methods for Measurement of the Effect of Effluent Upon Primary and Secondary Producers,
W83-03317 5A

NIKITINA, YU. H.
Barrier Effect of Various Methods for Desalinating Seawater in the Presence of Chemical Pollutants (Obezzarazhivayushchii Effekt Razlichnykh Metodov Opresneniya Morskoi Vody V Usloviyakh ee Khimicheskogo Zagryazneniya),
W83-03404 3A

NORRIS, P. E.
Soil Conservation and Water Quality Improvement: What Farmers Think,
W83-03161 4D

NORTON, S. A.
Radon-222 in Potable Water Supplies in Maine: The Geology, Hydrology, Physics and Health Effects,
W83-03308 2K

NOTESTINE, T.
Water Quality of the Upper Spokane River and Evaluation of Methods for Measurement of the Effect of Effluent Upon Primary and Secondary Producers,
W83-03317 5A

NOWAK, T. J.
The Start-up and Testing of a 6,000 GPD Indirect Freeze Desalination Pilot Plant,
W83-03468 3A

OBDAM, A.
Reliability and Verification of Geohydrologic Models (Zuverlassigkeit Und Verifikation Von Geohydrologischen Modellen),
W83-03448 2F

OGAWA, H.
The Flood Mitigation Potential of Inland Wetlands,
W83-03349 6A

OGER, P.
Use of Anaerobic Digestion in the Agricultural and Food Industries (Application De La Degestion Anaerobie Dans Les Industries Agro-Alimentaires),
W83-03252 5D

OHLINE, R. W.
Effects of Coal Burning in New Mexico on Air Quality and Surface Water Quality: Raton Study Area,
W83-03382 2K

OKUMURA, K.
Fluorimetric Determination of Chloroform in Drinking Water,
W83-03190 5A

OSBORN, C. T.
The Costs and Benefits of Soil Erosion Control in the North Lake Chicot Watershed,
W83-03331 4D

OSMOND, J. K.
Radioelements, Radiogenic Helium and Age Relationships for Groundwaters From the Granites at Stripa, Sweden,
W83-03208 2F

OSSENBRUGGEN, P. J.
Optimization and Dynamic Control of the Coagulation Process in Water Treatment,
W83-03373 5F

PADGETT, G. G.
Ground Water Quantity and Quality in Fracture Zones in Abbeville County, South Carolina,
W83-03466 3B

PANNELA, G.
Geohydrology of the Rio Camuy Cave System, Puerto Rico,
W83-03283 2F

PAPARO, A. A.
Identification of the Water Quality Factors Which Prevent Fingernail Clams From Recolonizing the Illinois River, Phase III,
W83-03463 5C

PAPPAS, P.
Water Quality Transmission and Runoff From Easily Crusted Erodable Soils and Mine Spoils. Effects of In-Situ Crosslinkable Oil Treatments,
W83-03269 4D

PARIS, M. V.
Comparative Study of the Causes and Effects of Recent Southeastern Droughts,
W83-03297 2B

PARKER, B. C.
In Situ Nitrogen (C2H2) Fixation in Lakes of Southern Victoria Land, Antarctica,
W83-03203 2H

PASSINO, R.
Advanced Wastewater Treatment by Ion Exchange,
W83-03196 5D

PELLEGRINI, M. G.
Macro and Trace-Elements in Drinking Water and Foods. Part 2 (Macro Ed Oligoelementi Nell'Apporto Idrico Ed Alimentare. Nota 2),
W83-03483 5B

PENNEQUIN, D. F.
The Groundwater Budget of Lake Wingra, Dane County, Wisconsin,
W83-03305 2F

PERALTA, R. C.
Evaluation and Accessing of Data for a Water Resources Simulator,
W83-03334 7A

Monitoring of Groundwater Levels for Real-Time Conjunctive Water Management,
W83-03333 7B

PERDUE, E. M.
Modification of Pollutant Hydrolysis Kinetics in the Presence of Humic Substances,
W83-03193 5B

PERRIER, A.
Field Study of Actual Evapotranspiration of a Wheat Crop (Etude 'In Situ' De L'Evapotranspiration Reelle D'une Culture De Ble),
W83-03389 2D

PETERS, R. W.
Effect of Iron as a Trace Impurity on the Water Softening Process,
W83-03411 5F

PETERSEN, G. W.
On-Site Sewage Disposal: Site Suitability, System Selection and Soil Absorption Area Sizing,
W83-03268 5D

PETERSON, D. A.
Surface Irrigation as Affected by Ash from Mount St. Helens,
W83-03285 2J

PHELPS, H. L.
The Effect of Aufwuchs Copper on Spat Settlement of the Oyster, Crassostrea Virginica,
W83-03429 5C

PHILLIPS, B. N.
Expansion Potential for Irrigation Within the Mississippi Delta Region,
W83-03345 6B

PICERNO, I.
Viral Contamination of Seawater at Messina (Inquinamento Di Natura Virale Delle Acque Di Mare Della Citta'Di Messina),
W83-03484 5B

PICOT-REBOUL, B.
Study of the Changes in River Water Quality (Etude De L'Evolution De La Qualite Des Eaux De Riviere),
W83-03267 5B

PIKUSH, N. V.
Hydrobiology of the Littoral Zone of the Dnieper Estuary Under Conditions of Regulated Flow of the River,
W83-03480 6G

PINDUCCIU, G.
Physical, Chemical, and Biological Characteristics of Lake Omodeo, Part II: Possibility of Using Impounded Water for Supplying Oristano City (Fenomeni Biologici Di Un Lago Artificiale Di Antica Data: Lago Omodeo, Nota II: Sulla Possibilita Di Utilizzare Le Acque Dell'Invaso Per La Alimentazione Idrica Della Citta Di Oristano),
W83-03477 5F

PISANI, D. J.
The Evolution of California State Water Planning 1850-1928,
W83-03274 6E

PLATT, R. H.
Flood Loss Reduction Through Interstate Compacts: An Under-Utilized Approach,
W83-03324 6F

PLIGIN, Y. V.
Hydrobiology of the Littoral Zone of the Dnieper Estuary Under Conditions of Regulated Flow of the River,
W83-03480 6G

POHLAND, F. G.
Identification and Assessment of Effluent Residuals in Treated Leachate from Landfill Disposal Sites,
W83-03272 5E

POLL, K. G.
On the Analysis of Trace Elements Harmful to Humans in River Sediments (Zur Analytik Humangefahrlicher Spurenelemente in Flusssediment),
W83-03442 5A

POON, C. P. C.
UV-Ozone Process for the Concurrent Decomposition of Halogenated Alkanes and the Disinfection of Water,
W83-03338 5F

POPOFF, G.
Trace Toxic Metals Determination in Natural Waters Using X-Ray Fluorescence Spectrometry on a Chelating Resin Captor (Determination De Traces Metaux Toxiques Dans Les Eaux Naturelles Par Spectrometrie De Fluorescence X Sur Capteur De Resine Chelatante),
W83-03414 5A

POPP, C. J.
Effects of Coal Burning in New Mexico on Air Quality and Surface Water Quality: Raton Study Area,
W83-03382 2K

An Evaluation of Sediments in the Middle Rio Grande, Elephant Butte Reservoir, and Caballo Reservoir as Potential Sources for Toxic Meterials,
W83-03322 5B

PORTIER, K. M.
Effect of Aquatic Macrophytes on Physico-Chemical Parameters of Agricultural Drainage Water,
W83-03153 5G

POSEY, I. J.
The Fate of Antifoulant Organotin Compounds in Water Systems,
W83-03315 5B

POST, A.
Calving Speed of Alaska Tidewater Glaciers, With Application to Columbia Glacier,
W83-03358 2C

POWELL, G. V. N.
Industrial Effluents as a Source of Mercury Contamination in Terrestrial Riparian Vertebrates,
W83-03402 5B

PROKOPOVICH, N. P.
Soil Collapses on Shores of Clear Lake Reservoir, Modoc County, California,
W83-03189 8A

PUPKOV, V. A.
Zoobenthos of Lakes of Black Sea Reservation (Preserve),
W83-03479 2H

PUYEAR, R. L.
Identification and Quantification of Water Soluble Components of Outboard Motor Exhaust and of Gasoline in a North Dakota Lake,
W83-03428 5A

QIANG, G. -Y.
Management of Human Excreta,
W83-03191 5D

QUINN, M. L.
Managing for Waves on Nebraska's Lake McConaughy - An Overview,
W83-03426 8A

QUINONES, F.
Hydrology of Area 14, Eastern Coal Province, Kentucky,
W83-03355 7C

RAIBLE, R. W.
Causes of Localized Copper Corrosion in Drinking Water Supplies,
W83-03346 5F

RAKHMANIN, YU. A.
Barrier Effect of Various Methods for Desalinating Seawater in the Presence of Chemical Pollutants (Obezzarazhivayushchii Effekt Razlichnykh Metodov Opresneniya Morskoi Vody V Usloviyakh ee Khimicheskogo Zagryazneniya),
W83-03404 3A

RAMSEY, R. E.
Identification and Assessment of Effluent Residuals in Treated Leachate from Landfill Disposal Sites,
W83-03272 5E

RANDALL, J. H.
Effects of Groundwater Pumpage on Surface and Groundwater Flows on Adjoining Basins,
W83-03431 4B

REDDY, J. M.
Analysis of Basin Irrigation Performance with Variable Inflow Rate,
W83-03410 3F

REDDY, K. R.
Effect of Aquatic Macrophytes on Physico-Chemical Parameters of Agricultural Drainage Water,
W83-03153 5G

Fate of Nitrogen and Phosphorus in a Waste-Water Retention Reservoir Containing Aquatic Macrophytes,
W83-03154 5D

REEVES, H. E.
Irrigation Water Conservation by Using Wide-Spaced Furrows,
W83-03408 3F

REICHEL, B.
On the Analysis of Trace Elements Harmful to Humans in River Sediments (Zur Analytik Humangefahrlicher Spurenelemente in Flusssediment),
W83-03442 5A

REICHEL, B. R.
On the Analysis of Trace Elements Harmful to Humans in River Sediments (Zur Analytik Humangefahrlicher Spurenelemente in Flusssediment),
W83-03442 5A

REILY, P. W.
The Effects of Altered Hydrologic Regime on Tree Growth Along the Missouri River in North Dakota,
W83-03262 6G

RENWICK, W.
Flood Control Effectiveness of Systems of Dual Purpose Detention Basins,
W83-03350 4A

RESCH, H.
New Design Guidelines for Vertical-Current Final Settling Tanks for Activated Sludge Plants (Neue Bemessungs-Grundlagen Fur Vertikal Durchstromite Nachklarkecken Von Belebungsanlagen),
W83-03437 5D

RICCIONI, R.
Macro and Trace-Elements in Drinking Water and Foods. Part 2 (Macro Ed Oligoelementi Nell'Apporto Idrico Ed Alimentare. Nota 2),
W83-03483 5B

RICE, T. L.
Sediment Deposition Model for Reservoirs Based on the Dominant Physical Processes,
W83-03417 2J

RICHARDSON, J.
Water Quality Transmission and Runoff From Easily Crusted Erodable Soils and Mine Spoils. Effects of In-Situ Crosslinkable Oil Treatments,
W83-03269 4D

RIETVELD, W.
Sampling Macrofauna in Ditches,
W83-03217 7B

RIJSTENBIL, J. W.
The Influence of Micro-Algae on the Oxygen Dynamics in a Brackish Ditch,
W83-03215 5C

Saline Seepage and Vertical Distribution of Oxygen in a Brackish Ditch,
W83-03216 5C

RITTER, W. F.
Influence of Agricultural Drainage on Water Quality,
W83-03289 5B

RIVERA, J.
Control of Trihalomethanes in Barcelona's Water Supply (Controle Des Trihalomethanes Dans Les Eaux D'Approvisionnement De Barcelone),
W83-03210 5B

RIVIERE, D.
Changes in Esterase Zymograms of a Planktonic Copepod, Acartia Clausi, in a Polluted Marine Area (Sewage Output of Marseilles) (Modifications Des Zymogrammes Des Esterases D'Un Copepode Planctonique, Acartia Clausi Dans Une Emissaire De Marseille),
W83-03386 5C

ROBERTS, K. L.
The Role of Cationic Surfactants in the Renovation of Water,
W83-03275 5F

ROE, E. M.
Agricultural Irrigation Technology Transfer Assessment,
W83-03281 3F

ROHLICH, G. A.
Surface Water Quality in the Border Area Between El Paso and the Gulf of Mexico,
W83-03500 5G

ROSS, I. J.
Effects of Surface Application of Dairy Manure on the Infiltration Rate and Quality of Surface Runoff,
W83-03344 5B

ROTHMEIER, F.
Model Rainfall for Sewer System Design Current Knowledge and Recommendations (Modellregren Zur Kanalnetzbemessung - Kenntnisstand Und Empfehlungen),
W83-03453 2A

Obtaining Rainfall Intensity Curves from Munich Rainfall Records (Die Ermittlung Von Regenspendelinien Aus Munchner Regenschreiberaufzeichnungen),
W83-03452 2B

ROUX, M.
Study of the Changes in River Water Quality (Etude De L'Evolution De La Qualite Des Eaux De Riviere),
W83-03267 5B

ROY, D.
Aquatic Ecology Monitoring Network of the James Bay Power Co. (Le Reseau De Surveillance D'Ecologie Aquatique De La Societe D'Energie De La Baie James),
W83-03394 6G

RUSEV, B. K.
Species Composition and Distribution of the Macrozoobenthos of the Maritsa River (Vidov Sustav I Razpredelenie Na Makrozoobentosa Ot Reka Maritsa),
W83-03474 5C

RUSSEV, B. K.
Tendencies in the Changes in the Saprobic Conditions of the Maritsa River (Tendentsii V Izmenenyata Na Saprobiolodgichnoto Sustoyanie Na Reka Maritsa),
W83-03473 5C

RUSSI, H.
Photoinduced Hydroxylation Reactions of Organic Chemicals in Natural Waters, Nitrates as Potential OH Radical Sources (Photoinduzierte Hydroxylierungsreaktionen Organischer Chemi-

kalien in Naturlichen Gewassern, Nitrate Als Potentielle Oh-Radikalquellen),
W83-03385 5B

RYAN, D. K.
Copper(II) Complexing Capacities of Natural Waters by Fluorescence Quenching,
W83-03396 5A

RYANS, R. A.
Pyrite and Oxidized Iron Mineral Phases Formed from Pyrite Oxidation in Salt Marsh and Estuarine Sediments,
W83-03451 2L

SACCO, P. D.
Effect of Aquatic Macrophytes on Physico-Chemical Parameters of Agricultural Drainage Water,
W83-03153 5G

SAGE, A. L. III
The Escatawpa River - An Interstate Approach to Water Resource Management,
W83-03354 6E

SALAUN, J. P.
Polarographic Determination of Low Levels of Cyanide and Metals in the Waste-Waters Discharged by an Electroplating Plant (Dosages Polarographiques de Faibles Quantities D'Ions Cyanure et de Metaux Dans Les Euax Rejetees Par un Atelier de Galvanoplastie),
W83-03412 5A

SALVADORI, O.
Relationships Among the Bacteria Indicators of Fecal Pollution in the Water of the River Brenta (Relazioni Tra Gli Indicatori Di Inquinamento Fecale Nelle Acque Del Fiume Brenta)
W83-03485 5A

SANDERS, T. G.
Regional Detection of Change in Water Quality Variables,
W83-03295 2A

SANDUSKY, M. J.
Identification of the Water Quality Factors Which Prevent Fingernail Clams From Recolonizing the Illinois River, Phase III,
W83-03463 5C

SANTONI, B.
Determination of PAH in Water and Sediments by Low Temperature Fluorimetry (Dosage Des Hydrocarbures Aromatiques Polynucleaires Dan Les Eaux Et Les Sediments Par Fluorimetrie A Basse Temperature),
W83-03413 5A

SCHALEKAMP, M.
The Zurich Water Supply System,
W83-03229 5F

SCHINTU, M.
Physical, Chemical, and Biological Characteristics of Lake Omodeo, Part II: Possibility of Using Impounded Water for Supplying Oristano City (Fenomeni Biologici Di Un Lago Artificiale Di Antica Data: Lago Omodeo, Nota II: Sulla Possibilita Di Utilizzare Le Acque Dell'Invaso Per La Alimentazione Idrica Della Citta Di Oristano),
W83-03477 5F

SCHLEGEL, S.
Anaerobic Activated Sludge Treatment of Filtrates From Thermally Conditioned Sludges (Die Behandling Von Filtratwassern Thermisch Konditionierter Schlamme Nach Anaeroben Belebunsverfahren),
W83-03440 5D

SCHNEIDER, W.
Organic Matter Pollution of Groundwater Near Highways (Belastung Des Grundwassers Mit Organischen Stoffen Im Gebiet Von Strassen),
W83-03446 5B

SCHNOOR, J. L.
Distributed Source Model for Pesticides in the Iowa River,
W83-03186 5B

Molecular Size Determination of Chloroform Precursors,
W83-03187 5A

SCHOMAKER, J. H.
A Test for Inequity in River Recreation Reservation Systems,
W83-03175 6D

SCHULTZ, C. M.
The Efficacy of Removal of Heavy Metals from Water by Calcite,
W83-03157 5F

SCHULTZ, G.
Opportunities and Potential Benefits of Radar Rainfall Measurements for the Federal Republic of Germany (Moglichkeiten und Potentieller Nutzen Eines Bundesdeutschen Niederschlagsradar--Verbundsystems),
W83-03240 7B

SCHUSSLER, H.
Costs of Phosphate Elimination in Municipal Wastewater Facilities (Kosten Der Phosphatelimination in Kommunalen Klaranlagen),
W83-03436 5D

SCOTT, D. F.
An Economic Analysis of the Devils Lake Basin and Proposed Land Use,
W83-03270 6B

SEABURG, K. G.
In Situ Nitrogen (C2H2) Fixation in Lakes of Southerm Victoria Land, Antarctica,
W83-03203 2H

SEIDLITZ, U.
Efficient Utilization of Industrial Waster and Waste Heat for Intensive Fish Production (Die Rationelle Nutzung Von Industriewasser Und Abwarme Fur Eine Intensive Fischproduktion),
W83-03221 3C

SHANN, J. R.
Recovery and Transport of Heavy Metals by Spartina Alterniflora From Dredging Spoils,
W83-03381 2L

SHARDA, R.
Estimation of the Economic Worth of Water for Release Decisions,
W83-03280 6A

SHARPE, W. E.
Agricultural Irrigation Technology Transfer Assessment,
W83-03281 3F

SHELDON, A. L.
Cost and Precision in a Stream Sampling Program,
W83-03336 6C

SHULSTAD, R. N.
The Costs and Benefits of Soil Erosion Control in the North Lake Chicot Watershed,
W83-03331 4D

Expansion Potential for Irrigation Within the Mississippi Delta Region,
W83-03345 6B

SHULTZ, R. C.
Automated Strain Gage Dendrography for Improved Water Utilization in Plants,
W83-03372 2I

SIGLEO, A. C.
Composition of Estuarine Colloidal Material: Organic Components,
W83-03202 2L

SIGURDSSON, S.
The Chemistry of Geothermal Waters in Iceland. I. Calculation of Aqueous Specification from 0 to 370C,
W83-03201 2K

SIMMONS, G. M. JR.
In Situ Nitrogen (C2H2) Fixation in Lakes of Southerm Victoria Land, Antarctica,
W83-03203 2H

SIMONS, D. B.
Sediment Deposition Model for Reservoirs Based on the Dominant Physical Processes,
W83-03417 2J

SIMPSON, E. S.
Effects of Groundwater Pumpage on Surface and Groundwater Flows on Adjoining Basins,
W83-03431 4B

SIMPSON, R. L.
The Role of Delaware River Freshwater Tidal Wetlands in the Retention of Nutrients and Heavy Metals,
W83-03169 2L

SIMS, K. R.
The Development and Effect of Fish Attractors on the Tennessee-Tombigbee Waterway,
W83-03419 6G

SIMS, R. A.
Causes of Localized Copper Corrosion in Drinking Water Supplies,
W83-03346 5F

SINN, D. E.
The Responses of Plankton Communities in Experimental Ponds to Atrazine, the Most Heavily Used Pesticide in the United States,
W83-03255 5C

SIRONS, G. J.
Aquatic Plant Control and Disappearance of Terbutryn from Treated Waters in Ontario, Canada, 1974-1977,
W83-03166 4A

SIWON, Z.
Factors Influencing Hourly and Daily Water Demand (Uber Die Stunden-Und Tagewasserbedarf Beeinflussenden Faktoren),
W83-03438 6D

SKAGGS, R. W.
Field Evaluation of a Water Management Simulation Model,
W83-03238 4A

SKERGAN, T.
Evaluation and Accessing of Data for a Water Resources Simulator,
W83-03334 7A

SKOPINTSEV, B. A.
Material and Energy Balance of Organic Matter in the Waters of the Rybinsk Reservoir and Lake Baikal,
W83-03478 2H

SLATER, C. S.
Physiochemical Pretreatment of Landfill Leachates Using Coagulation,
W83-03172 5G

SMERDON, E. T.
Water-Its Role From Now to the Year 2000,
W83-03491 6D

SMITH, G. W.
Toward an Econometric Model to Analyze Impacts of Water Availability on the Oregon Economy,
W83-03326 6A

SMITH, J.
Returning the Tyne to Life,
W83-03231 5D

SMITH, R. E.
Field Rating Evaluation of a Large Supercritical Measurement Flume,
W83-03239 7B

SNIPES, D. S.
Ground Water Quantity and Quality in Fracture Zones in Abbeville County, South Carolina,
W83-03466 3B

SNYDER, W. M.
Basin-Scale Evapotranspiration Determination through Watershed and Climate Analyses,
W83-03328 2D

SOKOL, D.
Investigative Programs for Designing and Modeling Mine Water Control Systems,
W83-03265 4B

SOLBE, J. F.
Fish Farm Effluents--Cause for Concern,
W83-03237 5B

SOLOMAH, A. G.
Developments, Recommendations and Applications of Tests for Evaluating the Chemical Stability of High-Level Radioactive Solid Waste Forms,
W83-03427 5B

SOLT, G. S.
Water Management for Packaged Boiler Systems,
W83-03205 5F

SOMMERS, L. E.
Chemical Speciation of Leachates From Waste Disposal Sites,
W83-03432 5B

SONTHEIMER, H.
Groundwater Purification by Infiltration of Ozonized Water (Grundwassersanierung Durch Infiltration Von Ozontem Wasser),
W83-03200 5G

SOO-HOO, R.
Parametric Study of Seawater Reverse Osmosis Desalting Plants,
W83-03316 3A

SOROOSHIAN, S.
Response Surface Parameter Sensitivity Analysis Methods for Postcalibration Studies,
W83-03293 2A

SPANGENBERG, N. E.
Effects of Silvicultural Practices on Water Quality in Northern Wisconsin,
W83-03304 5G

SPARKS, R. E.
Identification of the Water Quality Factors Which Prevent Fingernail Clams From Recolonizing the Illinois River, Phase III,
W83-03463 5C

SPENCER, C. P.
Determination of Total Iodine and Iodate-Iodine in Natural Freshwater,
W83-03206 5A

A Seasonal Study of the Distributions of Surface State Variables in Liverpool Bay. III. An Offshore Front,
W83-03173 2L

SPRINGER, E. P.
Fecal Coliform Release Studies and Development of a Preliminary Nonpoint Source Transport Model for Indicator Bacteria,
W83-03376 5B

SPRINGSTON, G. E.
Ground Water Quantity and Quality in Fracture Zones in Abbeville County, South Carolina,
W83-03466 3B

STAMMANN, D.
Biological Wastewater Purification with Technical Oxygen (Biologische Abwasserreinigung Mit Techn. Reinem Sauerstoff),
W83-03443 5D

STEVENS, J. D.
Effect of Iron as a Trace Impurity on the Water Softening Process,
W83-03411 5F

STEVENS, T. H.
Use of Hedonic Price Technique to Evaluate Wetlands,
W83-03343 6B

STEWART, R. E. JR.
Forests, Wetlands and Waterfowl Populations in the Turtle Mountains of North Dakota and Manitoba,
W83-03181 2L

STONE, J. F.
Irrigation Water Conservation by Using Wide-Spaced Furrows,
W83-03408 3F

STONER, J. D.
Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigtion. Part 3: Canadian, North Canadian, and Deep Fork River Basins through 1979,
W83-03362 7C

STOUT, G. E.
Efficient Use of Water for Irrigation in the Upper Midwest,
W83-03282 6D

STRASKRABOVA, V.
Diel Changes in Numbers and Activities of Bacterioplankton in a Reservoir in Relation to Algal Production,
W83-03263 2H

STROKATENKO, G. I.
Trace Elements (Manganese, Zinc and Copper) in the USSR Part of the Danube River,
W83-03470 5B

STROUP, R.
An Economic Analysis of Obstacles to Water Conservation in Montana Water Law,
W83-03464 4B

STUART, J. D.
Organics Transported Through Selected Geologic Media: Assessment of Organics Transported Away From Industrial Waste Disposal Sites,
W83-03375 5A

SUCH, W.
Development and Status of Emergency Drinking Water Supply in the Federal Republic of Germany After Passage of the Water Safeguarding Law (Entwicklung und Stand Der Tinkwasser-Notversorgung in Der Bundesrepublik Nach Dem Wassersicherstellungsgesetz),
W83-03458 5F

SULLIVAN, K.
Use of Seepage Meters and Mini-Piezometers for Identification of Reservoir - Groundwater Interactions in Lake Mead, Nevada,
W83-03487 7B

SUMMERFELT, R. C.
Artificial Destratification to Prevent Winterkill,
W83-03299 5G

SUNDBORG, A.
Environmental Problems of Reservoir Development with Special Regard to Conditions in Sweden,
W83-03393 6G

SUTPHEN, R. L.
Mother Nature as Sludge Thickener,
W83-03227 5F

SVAVARSSON, H.
The Chemistry of Geothermal Waters in Iceland. I. Calculation of Aqueous Specification from 0 to 370C,
W83-03201 2K

SWAILES, D. W.
Removal of Nitrate, Sulfate and Hardness from Groundwater by Ion Exchange,
W83-03290 5F

SWALES, S.
A 'Before and After' Study of the Effects of Land Drainage Works on Fish Stocks in the Upper Reaches of a Lowland River,
W83-03192 6G

SWIFT, M. C.
Effects of Coal Pile Runoff on Stream Quality and Macro-Invertebrate Communities,
W83-03307 5C

SZABO, B. J.
Extreme Fractionation of U234/U238 and TH230/U234 in Spring Waters, Sediments, and Fossils at the Pomme De Terre Valley, Southwestern Missouri,
W83-03209 2K

SZECSODY, J. E.
Environmental Isotopic and Hydrogeochemical Investigation of Recharge and Subsurface Flow in Eagle Valley, Nevada,
W83-03380 2F

TALAEVA, YU. G.
Barrier Effect of Various Methods for Desalinating Seawater in the Presence of Chemical Pollutants (Obezzarazhivayushchii Effekt Razlichnykh Metodov Opresneniya Morskoi Vody V Usloviyakh ee Khimicheskogo Zagryazneniya),
W83-03404 3A

TALBOT, V.
Lead and Other Trace Metals in the Sediments and Selected Biota of Princess Royal Harbour, Albany, Western Australia,
W83-03399 5B

TALLMAN, D. E.
Characterization of Kel-F-Graphite Composite (Kelgraf) Electrodes and Application to Detection in Flowing Streams,
W83-03369 7B

TARAB, J. L.
Effects of Surface Application of Dairy Manure on the Infiltration Rate and Quality of Surface Runoff,
W83-03344 5B

TARANTINI, F.
Macro and Trace-Elements in Drinking Water and Foods. Part 2 (Macro Ed Oligoelementi Nell'Apporto Idrico Ed Alimentare. Nota 2),
W83-03483 5B

TEAGUE, W. R.
A Computer Model for Predicting the Impact of Irrigating with Saline Water on Soils and Runoff Water in Missouri,
W83-03284 3C

TEESENDORFF, H.
Berlin Water '81 -- 125 Years of Central Water Distribution (Wasser Berlin '81 -- 125 Jahre Zentrale Wasserversorgung),
W83-03455 5F

THELIN, R.
Fecal Coliform Release Studies and Development of a Preliminary Nonpoint Source Transport Model for Indicator Bacteria,
W83-03376 5B

THOMSEN, T.
A Modified Sediment Transport Model for Natural Streams,
W83-03494 2J

THON, J.
Forecasting Methods in the Future Supply Area of the Rheintal Water Transmission Network (Beweissicherungsverfahren Im Kunftigen Wassergewinnungsgebiet Des Zweckverbands Fernwasserversorgung Rheintal (FWR),
W83-03456 3F

THORNE, M. D.
Efficient Use of Water for Irrigation in the Upper Midwest,
W83-03282 6D

TONNESSON, K.
The Potential for Acid Precipitation Damage to Lakes of the Sierra Nevada, California,
W83-03182 5B

TORRES-GONZALEZ, A.
Geohydrology of the Rio Camuy Cave System, Puerto Rico,
W83-03283 2F

TOWNER, G. D.
A Method for Improving Cheaply the Time Response of Pressure-Transducer Tensiometer Systems,
W83-03409 7B

TREMPER, W. B.
A Meteorological and Climatological Approach in Determining Snowpack Accumulation at Snow Course Sites in a Montana Watershed,
W83-03465 2A

TRIMBLE, S. W.
Soil Conservation and the Reduction of Erosion and Sedimentation in the Coon Creek Basin, Wisconsin,
W83-03356 4D

TRUESDALE, V. W.
Determination of Total Iodine and Iodate-Iodine in Natural Freshwater,
W83-03206 5A

TSAKIRIS, G. P.
A Method for Applying Crop Sensitivity Factors in Irrigation Scheduling,
W83-03384 3F

TUCKER, C. S.
Effects of Simazine Treatment on Channel Catfish Production and Water Quality in Ponds,
W83-03167 5G

TWEDT, T.
Index Construction for Multiple Objective Analysis of Land and Water Use in a High Mountain Watershed,
W83-03286 6A

TYSSELING, J.
Water Availability in the New Mexico Upper Rio Grande Basin to the Year 2000,
W83-03493 6D

UCHRIN, C. G.
Physiochemical Pretreatment of Landfill Leachates Using Coagulation,
W83-03172 5G

A Stochastic Model for Suspended Solids Settling Velocity,
W83-03158 2J

UNO, T.
Fluorimetric Determination of Chloroform in Drinking Water,
W83-03190 5A

USHER, A. J.
Multiple Use Reservoir Planning Approaches: Lac Seul, Northwestern Ontario,
W83-03211 6A

UZUNOV, J. I.
Species Composition and Distribution of the Macrozoobenthos of the Maritsa River (Vidov Sustav I Razpredelenie Na Makrozoobentosa Ot Reka Maritsa),
W83-03474 5C

The Species Deficit of the Macrozoobenthic Communities as a Criterion for the Transsaprobic Influences on the Maritsa River (Vidoviyat Defitsit Na Makrozoobentosnite Suobshchestva Kato Kriterii Za Transsaprobnite Vliyaniya Vurkhu Reka Maritsa),
W83-03475 5C

Tendencies in the Changes in the Saprobic Conditions of the Maritsa River (Tendentsii V Izmenenyata Na Saprobiolodgichnoto Sustoyanie Na Reka Maritsa),
W83-03473 5C

VAJDIC, A. H.
Prechlorination and Trihalomethane Formation at Water Treatment,
W83-03228 5F

VANDELANNOOTE, A.
Ecological Assessment of Water Quality: Comparison of Biological-Ecological Procedures in a Rain-Fed Lowland Waterway (Kleine Nete, N. Belgium),
W83-03214 5C

VANDOREN, S. R.
Development of a Cell Culture Screen for Water Toxicity,
W83-03306 5A

VANSICKLE, J.
Dynamic Modelling of Suspended Sediment Transport in Streams as a Function of Sediment Supply,
W83-03368 2J

VARMA, M. M.
Trihalomethane Removal and Formation Mechanism in Water,
W83-03430 5F

VENBURG, L. C.
Investigative Programs for Designing and Modeling Mine Water Control Systems,
W83-03265 4B

VENTURA, F.
Control of Trihalomethanes in Barcelona's Water Supply (Controle Des Trihalomethanes Dans Les Eaux D'Approvisionnement De Barcelone),
W83-03210 5B

VILLINGER, E.
Modified Monthly Minimum Method for Rapid Calculation of Groundwater Recharge from Receiving Stream Runoff (Das Modifizierte Verfahren MoMNO (r12) Zur Raschen Ermittlung Der Grundwasserneubildungsrate Aus Dem Vorfluterabfluss),
W83-03447 2F

VINNARD, A.
An Economic Analysis of Obstacles to Water Conservation in Montana Water Law,
W83-03464 4B

VISKANTA, R.
Experimental and Analytical Study of Heat Transfer and Mixing in Thermally Stratified Buoyant Flows,
W83-03370 2H

VITTIMBERGA, B. M.
UV-Ozone Process for the Concurrent Decomposition of Halogenated Alkanes and the Disinfection of Water,
W83-03338 5F

VOGL, E. C.
Chemical Effects of Selected Trace-Metals From Sanitary Landfill Leachates on Groundwater Quality,
W83-03340 5E

VOLKOVA, N. C.
Use of Polyethylene Imines in Flotation and Improving the Filtration of Suspensions of Blue-Green Algae,
W83-03471 5F

VOLTOLINA, D.
A Seasonal Study of the Distributions of Surface State Variables in Liverpool Bay. III. An Offshore Front,
W83-03173 2L

VOROB'EV, A. S.
Flushing of Reservoirs as a Means of Increasing the Operating Efficiency of Hydroelectric Stations,
W83-03198 8A

WALKER, D. G.
Gamekeeper, Poacher--The Welsh Wa Approach,
W83-03219 5F

WALKER, P. N.
Efficient Use of Water for Irrigation in the Upper Midwest,
W83-03282 6D

WALKER, R.
The Role of Delaware River Freshwater Tidal Wetlands in the Retention of Nutrients and Heavy Metals,
W83-03169 2L

WANGNICK, K.
Barge-Mounted Plant for Desalination: An Economical Alternative for Providing Drinking Water in Arid Regions,
W83-03179 3A

WARNICK, C. C.
Hydrologic Flow Determination for Hydropower Feasibility Analysis,
W83-03271 2E

A Manual for Developing Small-Scale and Micro-Hydropower Plants in Idaho - A Guide to Permits, Licenses, and Incentives,
W83-03320 6E

WASLENCHUK, D.
Concentration, Reactivity and Fate of Copper, Nickel, and Zinc Associated with a Cooling-Water Plume in Estuarine Waters, II. The Particulate Phase,
W83-03398 5B

WATSON, M. D.
Current Stormwater Drainage Practice in South Africa,
W83-03387 4A

WEATHERFORD, G.
California Groundwater Management: The Sacred and the Profane,
W83-03498 6E

WEAVER, G. D.
Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

WEBER, J. H.
Copper(II) Complexing Capacities of Natural Waters by Fluorescence Quenching,
W83-03396 5A

WEBER, W. J. JR.
A Stochastic Model for Suspended Solids Settling Velocity,
W83-03158 2J

WEETER, D. W.
The Role of Cationic Surfactants in the Renovation of Water,
W83-03275 5F

WEICHERT, A. T.
Assessment of Stormflow and Water Quality From Undisturbed and Site Prepared Forest Land in East Texas,
W83-03277 4C

WEIFFENBACH, C. V.
Radon-222 in Potable Water Supplies in Maine: The Geology, Hydrology, Physics and Health Effects,
W83-03308 2K

WEIMER, D.
Promising Experiments on Leak Location by Means of Correlation (Aussichtsreiche Versuche Zur Leckortung Mittels Korrelation),
W83-03445 5F

WEISSHAAR, D. E.
Application of Kelgraph to Electrochemical Detectors for Flow Injection Analysis and High Performance Liquid Chromatography,
W83-03490 5A

Characterization of Kel-F-Graphite Composite (Kelgraf) Electrodes and Application to Detection in Flowing Streams,
W83-03369 7B

WELLING, T. G.
The Movement of Nitrates, Phosphates, and Fecal Coliform Bacteria From Disposal Systems Installed in Selected Connecticut Soils,
W83-03276 5B

WERNER, M. D.
An Experimental Investigation of the Effects of Crude Oil on Two Freshwater Lake Ecosystems,
W83-03273 5C

WERNER, P.
Groundwater Purification by Infiltration of Ozonized Water (Grundwassersanierung Durch Infiltration Von Ozontem Wasser),
W83-03200 5G

WESTERDAHL, H. E.
Effect of Hydout and Aquathol K on Hydrilla in Gatun Lake, Panama,
W83-03162 4A

Threshold 2,4-D Concentrations for Control of Eurasian Watermilfoil and Sago Pondweed,
W83-03163 4A

WEYDERT, O.
Sedimentologic Study of the Mouth of the Gabon River Estuary (Etude Sedimentologique De L'Embouchure De L'Estuaire Du Gabon),
W83-03257 2L

WEYDERT, P.
Sedimentologic Study of the Mouth of the Gabon River Estuary (Etude Sedimentologique De L'Embouchure De L'Estuaire Du Gabon),
W83-03257 2L

WHANG, J. S.
Water Reuse and Recycling in the Textile Industry,
W83-03178 3E

WHEATLEY, W. B.
A Novel Bactericidal Agent for Treatment of Water,
W83-03337 5F

WHEELER, D. C.
Applications of a Serratia Marcescens Bacteriophage as a New Microbial Tracer of Aqueous Environments,
W83-03165 5B

WHIPPLE, W. JR
Flood Control Effectiveness of Systems of Dual Purpose Detention Basins,
W83-03350 4A

WIEGAND, N. K.
Flood Control Effectiveness of Systems of Dual Purpose Detention Basins,
W83-03350 4A

WIERSMA, J. L.
Wind Energy for Low Head Irrigation,
W83-03309 8C

WILHELM, W. W.
Water and Energy Conservation Using Center Pivot Irrigation and Reduced Tillage Systems,
W83-03342 3F

WILLIS, L. D.
Effects of Sewage Pollution in the White River, Arkansas on Benthos and Leaf Detritus Decomposition,
W83-03332 5C

WILSON, S. K.
Rainfall Cell Size From Rit Curve Analysis,
W83-03339 2B

WINDHAM, M. P.
Fecal Coliform Release Studies and Development of a Preliminary Nonpoint Source Transport Model for Indicator Bacteria,
W83-03376 5B

WITTENBERG, H.
Contribution to the Measurement of Evaporation in Remote Stations (Beitrag Zur Verdunstungsmessung in Abgelegenen Stationen),
W83-03225 7B

WOESSNER, W. W.
Use of Seepage Meters and Mini-Piezometers for Identification of Reservoir - Groundwater Interactions in Lake Mead, Nevada,
W83-03487 7B

WOLFE, N. L.
Modification of Pollutant Hydrolysis Kinetics in the Presence of Humic Substances,
W83-03193 5B

WOOD, D. J.
Hydraulic Analysis of Surcharged Storm Sewer Systems,
W83-03374 8B

WORLEY, S. D.
A Novel Bactericidal Agent for Treatment of Water,
W83-03337 5F

WRIGHT, W. R.
Phosphate Release in Laboratory Soil Columns,
W83-03301 5B

WYNNE, D.
The Uptake of Dissolved Nitrogenous Nutrients by Lake Kinneret (Israel) Microplankton,
W83-03260 2H

YAMAMOTO, M.
Evaluating the Release of Soluble Components from Sediment,
W83-03168 5B

YANEVA, I. Y.
Species Composition and Distribution of the Macrozoobenthos of the Maritsa River (Vidov Sustav I Razpredelenie Na Makrozoobentosa Ot Reka Maritsa),
W83-03474 5C

Tendencies in the Changes in the Saprobic Conditions of the Maritsa River (Tendentsii V Izmenenyata Na Saprobiolodgichnoto Sustoyanie Na Reka Maritsa),
W83-03473 5C

YAW, R. H.
A Meteorological and Climatological Approach in Determining Snowpack Accumulation at Snow Course Sites in a Montana Watershed,
W83-03465 2A

YAZIZ, M. I.
The Removal of Salmonella Enteritidis in Activated Sludge,
W83-03152 5D

YEH, W. W. -G.
Worth of Inflow Forecast for Reservoir Operation,
W83-03296 4A

YI, B. -J.
A Methodology for Algal Population Study of Periphyton: Measurement of Covering Rate (Une Methodologie Pour L Etude Des Populations Algales Du Periphyton: La Mesure Du Taux De Recouvrement),
W83-03407 5A

YORK, K.
Hydrology of Area 14, Eastern Coal Province, Kentucky,
W83-03355 7C

YOUNG, R. A.
Economic Impacts of Transferring Water From Agriculture to Alternative Uses in Colorado,
W83-03303 6D

ZABEL, T.
Fit to Drink,
W83-03236 5F

ZAJICEK, O. T.
The Role of Fulvic Substances on Trace Metal Partitioning in Natural Aquatic Sediments,
W83-03348 2K

ZETTLEMOYER, R.
Worth of Inflow Forecast for Reservoir Operation,
W83-03296 4A

ZIGLIO, G.
Drinking Water Contamination with Chloro-Organic Compounds: Sources, Health Effects, Control (Contaminazione Delle Acque Potabili Da Composti Cloro-Organici: Origine, Effetti Biologici, Misure Di Protezione E Di Controllo),
W83-03476 5F

ZIMBALEVSKAYA, L. N.
Hydrobiology of the Littoral Zone of the Dnieper Estuary Under Conditions of Regulated Flow of the River,
W83-03480 6G

ZITELLI, A.
Relationships Among the Bacteria Indicators of Fecal Pollution in the Water of the River Brenta (Relazioni Tra Gli Indicatori Di Inquinamento Fecale Nelle Acque Del Fiume Brenta)
W83-03485 5A

ZUBENKO, I. B.
Trace Elements (Manganese, Zinc and Copper) in the USSR Part of the Danube River,
W83-03470 5B

ZUBENKO, Y. B.
Biological Role of Perch in the Kremenchug Reservoir,
W83-03472 2H

ORGANIZATIONAL INDEX

AGRICULTURAL RESEARCH AND EDUCATION CENTER, SANFORD, FL.
Effect of Aquatic Macrophytes on Physico-Chemical Parameters of Agricultural Drainage Water,
W83-03153 5G

Fate of Nitrogen and Phosphorus in a Waste-Water Retention Reservoir Containing Aquatic Macrophytes,
W83-03154 5D

AGRICULTURAL RESEARCH SERVICE, DURANT, OK. WATER QUALITY AND WATERSHED RESEARCH LAB.
The Extent and Nature of Rainfall-Soil Interaction in the Release of Soluble Chemicals to Runoff,
W83-03170 5B

AKADEMIYA NAUK SSSR, BOROK. INST. BIOLOGII VNUTRENNYKH VOD.
Material and Energy Balance of Organic Matter in the Waters of the Rybinsk Reservoir and Lake Baikal,
W83-03478 2H

AKADEMIYA NAUK URSR, KHERSON. BLACK SEA STATE PRESERVE.
Zoobenthos of Lakes of Black Sea Reservation (Preserve),
W83-03479 2H

AKADEMIYA NAUK URSR, KIEV. INST. HIDROBIOLOGII.
Trace Elements (Manganese, Zinc and Copper) in the USSR Part of the Danube River,
W83-03470 5B

Use of Polyethylene Imines in Flotation and Improving the Filtration of Suspensions of Blue-Green Algae,
W83-03471 5F

Biological Role of Perch in the Kremenchug Reservoir,
W83-03472 2H

Hydrobiology of the Littoral Zone of the Dnieper Estuary Under Conditions of Regulated Flow of the River,
W83-03480 6G

ALLIS-CHALMERS CORP., CINCINNATI, OH. INDUSTRIAL PUMP DIV.
Centrifugal Pump Basics,
W83-03258 8C

ANTWERP UNIV., WILRIJK (BELGIUM). DEPT. OF CHEMISTRY.
Ecological Assessment of Water Quality: Comparison of Biological-Ecological Procedures in a Rain-Fed Lowland Waterway (Kleine Nete, N. Belgium),
W83-03214 5C

ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.
Effects of Groundwater Pumpage on Surface and Groundwater Flows on Adjoining Basins,
W83-03431 4B

ARIZONA UNIV., TUCSON. SCHOOL OF LAW.
Overview of Groundwater Law and Institutions in United States Border States,
W83-03496 6E

ARKANSAS GEOLOGICAL COMMISSION, LITTLE ROCK.
Use of Water in Arkansas, 1980,
W83-03367 6D

ARKANSAS UNIV. AT LITTLE ROCK. DEPT. OF ELECTRONICS AND INSTRUMENTATION.
Causes of Localized Copper Corrosion in Drinking Water Supplies,
W83-03346 5F

ARKANSAS UNIV., FAYETTEVILLE.
Effects of Sewage Pollution in the White River, Arkansas on Benthos and Leaf Detritus Decomposition,
W83-03332 5C

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY.
The Costs and Benefits of Soil Erosion Control in the North Lake Chicot Watershed,
W83-03331 4D

Expansion Potential for Irrigation Within the Mississippi Delta Region,
W83-03345 6B

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF AGRICULTURAL ENGINEERING.
Monitoring of Groundwater Levels for Real-Time Conjunctive Water Management,
W83-03333 7B

Evaluation and Accessing of Data for a Water Resources Simulator,
W83-03334 7A

ARMY ENGINEER DISTRICT, PORTLAND, OR.
Comparison of Reservoirs with Dissimilar Selective Withdrawal Capabilities: Effects on Reservoir Limnology and Release Water Quality,
W83-03422 5G

A Public Participation Decision to Fill a Pacific Northwest Reservoir,
W83-03423 6D

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS. ENVIRONMENTAL LAB.
Threshold 2,4-D Concentrations for Control of Eurasian Watermilfoil and Sago Pondweed,
W83-03163 4A

ARMY MEDICAL BIOENGINEERING RESEARCH AND DEVELOPMENT LAB., FORT DETRICK, MD.
Biodegradation of 1,3-Dinitrobenzene,
W83-03155 5B

AUBURN UNIV., AL. DEPT. OF CHEMISTRY.
A Novel Bactericidal Agent for Treatment of Water,
W83-03337 5F

BEAK CONSULTANTS LTD., TORONTO (ONTARIO).
The Evolution of Public Involvement in Reservoir Developments in Canada,
W83-03421 6G

BECHTEL GROUP, INC., SAN FRANCISCO, CA.
Parametric Study of Seawater Reverse Osmosis Desalting Plants,
W83-03316 3A

BERLINER ENTWASSERUNGSWERKE (GERMANY, F.R.).
Berlin Water '81 -- 125 Years of Central Water Distribution (Wasser Berlin '81 -- 125 Jahre Zentrale Wasserversorgung),
W83-03455 5F

BIRMINGHAM UNIV. (ENGLAND).
Water Industry Accountability Through the Ombudsman System,
W83-03233 6E

BOLTON INST. OF TECH. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
The Construction and Operation of an Articulated Laboratory Flow Channel,
W83-03230 8B

BROOKHAVEN NATIONAL LAB., UPTON, NY.
Effects of Simulated Acid Rain on Yields of Raphanus Sativus, Lactuca Sativa, Triticum Aestivum and Medicago Sativa,
W83-03195 5C

BUCKAU-WALTHER A.G., ESSEN (GERMANY, F.R.).
Barge-Mounted Plant for Desalination: An Economical Alternative for Providing Drinking Water in Arid Regions,
W83-03179 3A

BULGARIAN ACADEMY OF SCIENCES, SOFIA.
Tendencies in the Changes in the Saprobic Conditions of the Maritsa River (Tendentsii V Izmenenyata Na Saprobiolodgichnoto Sustoyanie Na Reka Maritsa),
W83-03473 5C

Species Composition and Distribution of the Macrozoobenthos of the Maritsa River (Vidov Sustav I Razpredelenie Na Makrozoobentosa Ot Reka Maritsa),
W83-03474 5C

CAGLIARI UNIV. (ITALY). IST. DI IGIENE.
Physical, Chemical, and Biological Characteristics of Lake Omodeo, Part II: Possibility of Using Impounded Water for Supplying Oristano City (Fenomeni Biologici Di Un Lago Artificiale Di Antica Data: Lago Omodeo, Nota II: Sulla Possibilita Di Utilizzare Le Acque Dell'Invaso Per La Alimentazione Idrica Della Citta Di Oristano),
W83-03477 5F

CALIFORNIA UNIV., BERKELEY.
The Potential for Acid Precipitation Damage to Lakes of the Sierra Nevada, California,
W83-03182 5B

CALIFORNIA UNIV., DAVIS. DEPT. OF HISTORY.
The Evolution of California State Water Planning 1850-1928,
W83-03274 6E

CALIFORNIA UNIV., LOS ANGELES. SCHOOL OF ENGINEERING AND APPLIED SCIENCE.
Worth of Inflow Forecast for Reservoir Operation,
W83-03296 4A

CALIFORNIA UNIV., SANTA BARBARA. DEPT. OF GEOLOGICAL SCIENCES.
Large Organic Debris and Anadromous Fish Habitat in the Coastal Redwood Environment: The Hydrologic System,
W83-03335 2E

CALIFORNIA UNIV., SANTA CRUZ. CENTER FOR COASTAL MARINE STUDIES.
Selenium in Reducing Waters,
W83-03266 5B

CASE WESTERN RESERVE UNIV., CLEVELAND, OH. INST. OF TECHNOLOGY.
Response Surface Parameter Sensitivity Analysis Methods for Postcalibration Studies,
W83-03293 2A

CEA CENTRE D'ETUDES NUCLEAIRES DE FONTENAY-AUX-ROSES (FRANCE).
Determination of PAH in Water and Sediments by Low Temperature Fluorimetry (Dosage Des Hydrocarbures Aromatiques Polynucleaires Dan Les Eaux Et Les Sediments Par Fluorimetrie A Basse Temperature),
W83-03413 5A

CENTRE UNIVERSITAIRE DE LUMINY, MARSEILLE (FRANCE).

CENTRE UNIVERSITAIRE DE LUMINY, MARSEILLE (FRANCE).
Changes in Esterase Zymograms of a Planktonic Copepod, Acartia Clausi, in a Polluted Marine Area (Sewage Output of Marseilles) (Modifications Des Zymogrammes Des Esterases D'Un Copepode Planctonique, Acartia Clausi Dans Une Emissaire De Marseille),
W83-03386 5C

CESKOSLOVENSKA AKADEMIE VED, PRAGUE. HYDROBIOLOGICKA LAB.
Diel Changes in Numbers and Activities of Bacterioplankton in a Reservoir in Relation to Algal Production,
W83-03263 2H

CHICAGO BRIDGE AND IRON CO., OAK BROOK, IL.
Fabrication of a 6,000 GPD Indirect Freezing Pilot Plant: Vol. 1,
W83-03462 3A

CHICAGO BRIDGE AND IRON CO., PLAINFIELD, IL.
The Start-up and Testing of a 6,000 GPD Indirect Freeze Desalination Pilot Plant,
W83-03468 3A

CLEMSON UNIV., SC. DEPT. OF BOTANY.
Investigation Into Effective Control Methods for Brazilian Elodea (Egeria Densa Planchon) in Lake Marion, S.C.,
W83-03433 4A

CLEMSON UNIV., SC. DEPT. OF CHEMISTRY AND GEOLOGY.
Ground Water Quantity and Quality in Fracture Zones in Abbeville County, South Carolina,
W83-03466 3B

COLORADO STATE UNIV., FORT COLLINS.
Assessing Enviromental Impacts of Open Water Disposal of Dredged Sediment,
W83-03251 6G

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURAL AND CHEMICAL ENGINEERING.
Analysis of Basin Irrigation Performance with Variable Inflow Rate,
W83-03410 3F

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Regional Detection of Change in Water Quality Variables,
W83-03295 2A

Technology Assessment of Irrigation Scheduling and Crop Response,
W83-03488 3F

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF ECONOMICS.
Economic Impacts of Transferring Water From Agriculture to Alternative Uses in Colorado,
W83-03303 6D

Effects of Wilderness Legislation on Water Project Development in Colorado,
W83-03489 6G

COMPANHIA ENERGETICA DE SAO PAULO (BRAZIL).
Building Brazil's Nova Avanhandava Dam,
W83-03253 8A

CONNECTICUT UNIV., GROTON. MARINE SCIENCES INST.
Concentration, Reactivity and Fate of Copper, Nickel, and Zinc Associated with a Cooling-Water Plume in Estuarine Waters, II. The Particulate Phase,
W83-03398 5B

CONNECTICUT UNIV., STORRS. INST. OF WATER RESOURCES.
The Movement of Nitrates, Phosphates, and Fecal Coliform Bacteria From Disposal Systems Installed in Selected Connecticut Soils,
W83-03276 5B

The Effect of Hormonal Pollutants on Aquatic Crustacea and the Surrounding Environment,
W83-03314 5C

Organics Transported Through Selected Geologic Media: Assessment of Organics Transported Away From Industrial Waste Disposal Sites,
W83-03375 5A

CONNOR DEVELOPMENT SERVICES LTD., OAKVILLE (ONTARIO).
Citizen Participation in the Design and Management of Reservoirs,
W83-03418 6A

COPENHAGEN UNIV. (DENMARK). INST. OF GEOGRAPHY.
A Modified Sediment Transport Model for Natural Streams,
W83-03494 2J

CORPS OF ENGINEERS, MOBILE, AL. MOBILE DISTRICT.
The Development and Effect of Fish Attractors on the Tennessee-Tombigbee Waterway,
W83-03419 6G

DECHEMA, FRANKFURT AM MAIN (GERMANY, F.R.).
Monitoring Flocculation in Water Treatment Using a Computer-Controlled Physical Model (Uberwachung der Wasseraufbereitung Mit Hilfe Eines Rechnergesteuerten Physikalischen Modells),
W83-03439 5F

DELAWARE UNIV., NEWARK. DEPT. OF AGRICULTURAL ENGINEERING.
Influence of Agricultural Drainage on Water Quality,
W83-03289 5B

DELAWARE UNIV., NEWARK. SCHOOL OF LIFE AND HEALTH SCIENCES.
New Approaches to Measuring Total Bacterial Populations in Water Supplies,
W83-03292 5A

DELTA BRANCH EXPERIMENT STATION, STONEVILLE, MS.
Effects of Simazine Treatment on Channel Catfish Production and Water Quality in Ponds,
W83-03167 5G

DELTA INST. FOR HYDROBIOLOGICAL RESEARCH, YERSEKE (NETHERLANDS).
The Influence of Micro-Algae on the Oxygen Dynamics in a Brackish Ditch,
W83-03215 5C

Saline Seepage and Vertical Distribution of Oxygen in a Brackish Ditch,
W83-03216 5C

DEMOKRITOS UNIV. OF THRACE, XANTHI (GREECE). DEPT. OF CIVIL ENGINEERING.
A Method for Applying Crop Sensitivity Factors in Irrigation Scheduling,
W83-03384 3F

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, PETONE (NEW ZEALAND). CHEMISTRY DIV.
'Geothermal Mineral Equilibria.' Reply to a Comment by M. A. Grant,
W83-03416 2K

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, WELLINGTON (NEW ZEALAND). APPLIED MATHEMATICS DIV.
On the Lack of a Unique Relation Between C02 Partial Pressure and Temperature in Geothermal System. Comment on 'Geothermal Mineral Equilibria' by W. F. Giggenbach,
W83-03434 2K

DEUTSCHER VEREIN DES GAS- UND WASSERFACHES E.V., ESCHBORN (GERMANY, F.R.).
The Meaning of the Generally Accepted Technological Standards for the Planning, Construction, and Operation of Water Distribution Facilities (Die Bedeutung Der Anerkannten Regeln Der Technik Fur Planung, Bau und Betrieb Von Wasserversorgungsanlagen),
W83-03441 6E

DEUTSCHER WETTERDIENST, HOHENPEISSENBERG (GERMANY, F.R.). METEOROLOGISCHES OBSERVATORIUM.
Opportunities and Potential Benefits of Radar Rainfall Measurements for the Federal Republic of Germany (Moglichkeiten und Potentieller Nutzen Eines Bundesdeutschen Niederschlagsradar--Verbundsystems),
W83-03240 7B

DISTILLERIE COOPERATIVE AGRICOLE DE LA REGION D'AUVERNAUX (BELGIUM).
Use of Anaerobic Digestion in the Agricultural and Food Industries (Application De La Degestion Anaerobie Dans Les Industries Agro-Alimentaires),
W83-03252 5D

DISTRICT OF COLUMBIA UNIV., WASHINGTON. COLL. OF PHYSICAL SCIENCE, ENGINEERING, AND TECHNOLOGY.
The Fate of Antifoulant Organotin Compounds in Water Systems,
W83-03315 5B

DISTRICT OF COLUMBIA UNIV., WASHINGTON. DEPT. OF BIOLOGY.
The Effect of Aufwuchs Copper on Spat Settlement of the Oyster, Crassostrea Virginica,
W83-03429 5C

DUKE UNIV., DURHAM, NC. DEPT. OF ZOOLOGY.
Meromixis in an Equatorial African Soda Lake,
W83-03254 2H

EMSCHERGENOSSENSCHAFT, ESSEN (GERMANY, F.R.).
Anaerobic Activated Sludge Treatment of Filtrates From Thermally Conditioned Sludges (Die Behandling Von Filtratwassern Thermisch Konditionierter Schlamme Nach Anaeroben Belebunsverfahren),
W83-03440 5D

ENVIRONMENTAL RESEARCH LAB., ATHENS, GA.
Modification of Pollutant Hydrolysis Kinetics in the Presence of Humic Substances,
W83-03193 5B

ENVIRONMENTAL TECHNOLOGY CONSULTANTS, INC., FAIRFAX STATION, VA.
Water Reuse and Recycling in the Textile Industry,
W83-03178 3E

ERLANGEN-NUERNBERG UNIV. (GERMANY, F.R.). INST. FUER GEOLOGIE UND MINERALOGIE.
On the Analysis of Trace Elements Harmful to Humans in River Sediments (Zur Analytik Humangefahrlicher Spurenelemente in Flusssediment),
W83-03442 5A

FAIRFIELD COUNTY CONSERVATION DISTRICT, MONROE, CT.
Horses in Suburbia,
W83-03176 5G

FAIRLEIGH DICKINSON UNIV., TEANECK, NJ. COLL. OF SCIENCE AND ENGINEERING.
A Center for the Transfer of Desalination Technology,
W83-03352 3A

FISH AND WILDLIFE SERVICE, BISMARCK, ND.
Water Storage Capacity of Natural Wetland Depressions in the Devils Lake Basin of North Dakota,
W83-03160 2H

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Industrial Effluents as a Source of Mercury Contamination in Terrestrial Riparian Vertebrates,
W83-03402 5B

FLORIDA DEPT. OF NATURAL RESOURCES, ST. PETERSBURG. MARINE RESEARCH LAB.
Particulate Matter Resuspension Via Metabolically Produced Gas Bubbles From Benthic Estuarine Microalgae Communities,
W83-03261 2L

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Plastic Tanks: Pitfalls to Avoid,
W83-03250 8G

FREIBURG UNIV. (GERMANY, F.R.).
On The Esimation of the Error of Soil Moisture Measurement by Means of a Neutron Scattering Probe (Zur Abschatzung Des Fehlers Der Bodenfeuchte-Messung Mit Einer Neutronensonde),
W83-03242 7B

GEOLOGICAL SURVEY, ALBUQUERQUE, NM. WATER RESOURCES DIV.
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-5A, H-5B, and H-5C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03360 2K

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-6A, H-6B, and H-6C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W83-03361 2K

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Soil Conservation and the Reduction of Erosion and Sedimentation in the Coon Creek Basin, Wisconsin,
W83-03356 4D

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W83-03209 2K

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W83-03174 4D

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Johnstown-Western Pennsylvania Storm and Floods of July 19-20, 1977,
W83-03357 2E

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Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho--Emphasis: 1974-1978,
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Verification of Step-Backwater Computations on Ephemeral Streams in Northeastern Wyoming,
W83-03366 2E

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W83-03355 7C

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W83-03363 2L

GEOLOGISCHES LANDESAMT BADEN-WUERTTEMBERG, FREIBURG IM BREISGAU (GERMANY, F.R.).
Modified Monthly Minimum Method for Rapid Calculation of Groundwater Recharge from Receiving Stream Runoff (Das Modifizierte Verfahren MoMNO (r12) Zur Raschen Ermittlung Der Grundwasserneubildungsrate Aus Dem Vorfluterabfluss),
W83-03447 2F

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Production of Invertebrates in the Tidewater Zone of a Coastal River and Adjacent Estuary,
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Inverse-Voltammetry of Some Copper Chelates Using a Carbon Paste Electrode. Determination of Copper in Drinking Water by Oxidation of Copper Dithio-Oxamide (Zur Invers-Voltammetrie Einiger Kupferchelate an Der Kohlepaste-Electrode. Bestimmung Von Kupfer in Trinkwasser Durch Oxidation Von Kupferdithiooxamid),
W83-03415 5A

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W83-03385 5B

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W83-03224 6A

HARVARD UNIV., CAMBRIDGE, MA. MUSEUM OF COMPARATIVE ZOOLOGY.
The Uptake of Dissolved Nitrogenous Nutrients by Lake Kinneret (Israel) Microplankton,
W83-03260 2H

HAWAII UNIV. AT MANOA, HONOLULU. WATER RESOURCES RESEARCH CENTER.
Effect of Sunlight on Enumeration of Indicator Bacteria Under Field Conditions,
W83-03291 5A

Rainfall Cell Size From Rit Curve Analysis,
W83-03339 2B

Water Quality of Airport Storm Runoff,
W83-03353 5B

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Organic Matter Pollution of Groundwater Near Highways (Belastung Des Grundwassers Mit Organischen Stoffen Im Gebiet Von Strassen),
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Identification of the Water Quality Factors Which Prevent Fingernail Clams From Recolonizing the Illinois River, Phase III,
W83-03463 5C

ILLINOIS STATE GEOLOGICAL SURVEY DIV., CHAMPAIGN.
Undisturbed Core Method for Determining and Evaluating the Hydraulic Conductivity of Unsaturated Sediments,
W83-03319 2G

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. WATER RESOURCES CENTER.
Efficient Use of Water for Irrigation in the Upper Midwest,
W83-03282 6D

INGENIEURBURO GROMBACH G.M.B.H., BAD HOMBURG (GERMANY, F.R.).
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Vitrification of Pure Liquid Water by High Pressure Jet Freezing,
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W83-03388 3C

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W83-03404 3A

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Determination of Total Iodine and Iodate-Iodine in Natural Freshwater,
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W83-03210 5B

INTERNATIONAL ENGINEERING CO., INC., SAN FRANCISCO, CA.
Investigative Programs for Designing and Modeling Mine Water Control Systems,
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Effect of Incorporation of Fall-Applied Fertilizer on Runoff Losses of Nutrients and Soil From Soybean Ground,
W83-03298 2J

IOWA STATE UNIV., AMES. DEPT. OF ANIMAL ECOLOGY.
Artificial Destratification to Prevent Winterkill,
W83-03299 5G

A Survey of Water Transparency in Iowa Lakes,
W83-03371 5C

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W83-03377 6G

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W83-03411 5F

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W83-03290 5F

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Distributed Source Model for Pesticides in the Iowa River,
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Molecular Size Determination of Chloroform Precursors,
W83-03187 5A

IOWA UNIV., IOWA CITY. INST. OF HYDRAULIC RESEARCH.
Real-Time Forecasting of River Flows and Stochastic Optimal Control of Multireservoir Systems,
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Advanced Wastewater Treatment by Ion Exchange,
W83-03196 5D

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W83-03498 6E

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The Responses of Plankton Communities in Experimental Ponds to Atrazine, the Most Heavily Used Pesticide in the United States,
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W83-03200 5G

KEAN COLL. OF NEW JERSEY, UNION. DEPT. OF CHEMISTRY-PHYSICS.
Pyrite and Oxidized Iron Mineral Phases Formed from Pyrite Oxidation in Salt Marsh and Estuarine Sediments,
W83-03451 2L

KENT STATE UNIV., OH. DEPT. OF GEOLOGY.
Tufa Precipitation and its Effect on Drainage of Interstate Highways in Northeastern Ohio,
W83-03213 5B

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W83-03344 5B

Hydraulic Analysis of Surcharged Storm Sewer Systems,
W83-03374 8B

KNOLL A.G., MINDEN (GERMANY, F.R.).
Biological Wastewater Purification with Technical Oxygen (Biologische Abwasserreinigung Mit Techn. Reinem Sauerstoff),
W83-03443 5D

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Fluorimetric Determination of Chloroform in Drinking Water,
W83-03190 5A

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W83-03159 2L

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W83-03395 2C

LIVERPOOL UNIV. (ENGLAND).
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W83-03192 6G

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W83-03450 2L

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W83-03307 5C

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W83-03343 6B

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W83-03348 2K

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W83-03349 6A

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W83-03325 6G

Use of Seepage Meters and Mini-Piezometers for Identification of Reservoir - Groundwater Interactions in Lake Mead, Nevada,
W83-03487 7B

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W83-03222 5D

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W83-03396 5A

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The Concord Water Survey,
W83-03351 3D

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W83-03373 5F

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W83-03156 5B

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W83-03350 4A

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W83-03382 2K

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W83-03493 6D

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Landsat Monitoring of Irrigated Farmland Acreage in Curry County, New Mexico,
W83-03310 7A

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Priority Pollutants in Municipal Sewage Sludge, Part II,
W83-03406 5E

NEWFOUNDLAND AND LABRADOR HYDRO, ST. JOHN'S.
Development of a Reservoir Preparation Strategy,
W83-03420 6G

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING.
Field Evaluation of a Water Management Simulation Model,
W83-03238 4A

NORTH CAROLINA STATE UNIV. AT RALEIGH. SCHOOL OF ENGINEERING.
Developments, Recommendations and Applications of Tests for Evaluating the Chemical Stability of High-Level Radioactive Solid Waste Forms,
W83-03427 5B

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A Test for Inequity in River Recreation Reservation Systems,
W83-03175 6D

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF AGRICULTURAL ECONOMICS.
An Economic Analysis of the Devils Lake Basin and Proposed Land Use,
W83-03270 6B

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF CHEMISTRY.
Deuterium as a Tracer in the Groundwater Study of a Central North Dakota Mining Area,
W83-03177 5A

Water Quality Transmission and Runoff From Easily Crusted Erodable Soils and Mine Spoils. Effects of In-Situ Crosslinkable Oil Treatments,
W83-03269 4D

Characterization of Kel-F-Graphite Composite (Kelgraf) Electrodes and Application to Detection in Flowing Streams,
W83-03369 7B

Application of Kelgraph to Electrochemical Detectors for Flow Injection Analysis and High Performance Liquid Chromatography,
W83-03490 5A

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF ZOOLOGY.
Forests, Wetlands and Waterfowl Populations in the Turtle Mountains of North Dakota and Manitoba,
W83-03181 2L

Identification and Quantification of Water Soluble Components of Outboard Motor Exhaust and of Gasoline in a North Dakota Lake,
W83-03428 5A

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The Phytoplankton Ecology of Devils Lake,
W83-03180 2H

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Determination of the Complexing Capacity of Water Systems by Gel Chromatographic and Electrochemical Techniques,
W83-03185 5A

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Irrigation Water Conservation by Using Wide-Spaced Furrows,
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Development of a Cell Culture Screen for Water Toxicity,
W83-03306 5A

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Estimation of the Economic Worth of Water for Release Decisions,
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Computer Simulation of Local Destratification in Reservoirs,
W83-03279 5G

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The Biota of Oklahoma Springs: Natural Biological Monitoring of Groundwater Quality,
W83-03347 2H

OMAR BONGO UNIV., LIBREVILLE (GABON REPUBLIC). DEPT. OF GEOLOGY.
Sedimentologic Study of the Mouth of the Gabon River Estuary (Etude Sedimentologique De L'Embouchure De L'Estuaire Du Gabon),
W83-03257 2L

ONONDAGA COUNTY METROPOLITAN WATER BOARD, SYRACUSE, NY.
Mother Nature as Sludge Thickener,
W83-03227 5F

ONTARIO MINISTRY OF THE ENVIRONMENT, TORONTO.
Aquatic Plant Control and Disappearance of Terbutryn from Treated Waters in Ontario, Canada, 1974-1977,
W83-03166 4A

Prechlorination and Trihalomethane Formation at Water Treatment,
W83-03228 5F

OREGON STATE UNIV., CORVALLIS. DEPT. OF AGRICULTURAL AND RESOURCE ECONOMICS.
Toward an Econometric Model to Analyze Impacts of Water Availability on the Oregon Economy,
W83-03326 6A

OREGON STATE UNIV., CORVALLIS. SCHOOL OF FORESTRY.
Dynamic Modelling of Suspended Sediment Transport in Streams as a Function of Sediment Supply,
W83-03368 2J

PADUA UNIV. (ITALY). IST. DI IGIENE.
Relationships Among the Bacteria Indicators of Fecal Pollution in the Water of the River Brenta (Relazioni Tra Gli Indicatori Di Inquinamento Fecale Nelle Acque Del Fiume Brenta)
W83-03485 5A

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. COLL. OF AGRICULTURE.
On-Site Sewage Disposal: Site Suitability, System Selection and Soil Absorption Area Sizing,
W83-03268 5D

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. INST. FOR RESEARCH ON LAND AND WATER RESOURCES.
Agricultural Irrigation Technology Transfer Assessment,
W83-03281 3F

PUERTO RICO UNIV., MAYAGUEZ.
Geohydrology of the Rio Camuy Cave System, Puerto Rico,
W83-03283 2F

PUERTO RICO UNIV., MAYAGUEZ. DEPT. OF GENERAL ENGINEERING.
An Assessment of the Use Potential of the Flow of Water at the Spring 'Ojo de Agua' in Aguadilla, Puerto Rico,
W83-03321 4B

PUERTO RICO UNIV., MAYAGUEZ. QUALITY CONTROL LAB.
A Study of Eutrophication and Aquatic Plants Growths in Selected Lakes and Rivers of Puerto Rico,
W83-03300 5C

PURDUE UNIV., LAFAYETTE, IN. HEAT TRANSFER LAB.
Experimental and Analytical Study of Heat Transfer and Mixing in Thermally Stratified Buoyant Flows,
W83-03370 2H

PURDUE UNIV., LAFAYETTE, IN. SCHOOL OF CIVIL ENGINEERING.
Mathematical Modeling in Urban Hydrology,
W83-03486 2A

PURDUE UNIV., LAFAYETTE, IN. WATER RESOURCES RESEARCH CENTER.
Chemical Speciation of Leachates From Waste Disposal Sites,
W83-03432 5B

QUEEN ELIZABETH COLL., LONDON (ENGLAND). DEPT. OF MICROBIOLOGY.
Chemostat Adaptation of Escherichia Coli B/r/1 to Low Water Activity,
W83-03151 5D

RCA SERVICE CO., CAMDEN, NJ.
Final Results of Testing of Abcor 8 Inches Spiral Wound Ultra-Filters at The Wrightsville Beach Test Facility,
W83-03288 3A

REGIONAL CENTRE FOR ANIMAL NUTRITION AND BREEDING, HOFUF (SAUDI ARABIA).
Problems of Irrigated Agriculture in Al-Hassa, Saudi Arabia,
W83-03391 3C

RHODE ISLAND UNIV., KINGSTON. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
UV-Ozone Process for the Concurrent Decomposition of Halogenated Alkanes and the Disinfection of Water,
W83-03338 5F

RHODE ISLAND UNIV., KINGSTON. DEPT. OF PLANT AND SOIL SCIENCE.
Phosphate Release in Laboratory Soil Columns,
W83-03301 5B

Recovery and Transport of Heavy Metals by Spartina Alterniflora From Dredging Spoils,
W83-03381 2L

RIDER COLL., LAWRENCEVILLE, NJ. DEPT. OF BIOLOGY.
The Role of Delaware River Freshwater Tidal Wetlands in the Retention of Nutrients and Heavy Metals,
W83-03169 2L

RIJKSINSTITUUT VOOR DRINKWATERVOORZIENING, LEIDSCHENDAM (NETHERLANDS).
Reliability and Verification of Geohydrologic Models (Zuverlassigkeit Und Verifikation Von Geohydrologischen Modellen),
W83-03448 2F

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN (ENGLAND).DEPT. OF PHYSICS.
A Method for Improving Cheaply the Time Response of Pressure-Transducer Tensiometer Systems,
W83-03409 7B

ROUEN UNIV., MONT-SAINT-AIGNAN (FRANCE). LAB. DE CHIMIE ANALYTIQUE.
Polarographic Determination of Low Levels of Cyanide and Metals in the Waste-Waters Discharged by an Electroplating Plant (Dosages Polarographiques de Faibles Quantities D'Ions Cyanure et de Metaux Dans Les Euax Rejetees Par un Atelier de Galvanoplastie),
W83-03412 5A

ROYAL MILITARY COLL. OF SCIENCE, SHRIVENHAM (ENGLAND).
Radioelements, Radiogenic Helium and Age Relationships for Groundwaters From the Granites at Stripa, Sweden,
W83-03208 2F

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, NJ. CENTER FOR COASTAL AND ENVIRONMENTAL STUDIES.
Buffer Capacities of Fresh Water Lakes Sensitive to Acid Rain Deposition,
W83-03171 2H

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, NJ. DEPT. OF CHEMICAL AND BIOCHEMICAL ENGINEERING.
Physiochemical Pretreatment of Landfill Leachates Using Coagulation,
W83-03172 5G

Water Reuse in the Coastal Plain of New Jersey - A Case Study,
W83-03378 3C

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, NJ. DEPT. OF ENVIRONMENTAL SCIENCE.
The Efficacy of Removal of Heavy Metals from Water by Calcite,
W83-03157 5F

SALZGITTER A.G. (GERMANY, F.R.).
Contribution to the Measurement of Evaporation in Remote Stations (Beitrag Zur Verdunstungsmessung in Abgelegenen Stationen),
W83-03225 7B

SANITARNO-GIGIENICHESKII INST., TIFLIS (USSR).
Hygienic Evaluation of Hydrogen Sulfide-Containing Thermal Waters Used in Hot Water Supply Systems (Gigiena Otsenka Serovodnykh Termal'Nykh Vod, Ispol'Zuemykh V Sisteme Goryachego Vodosnabzheniya),
W83-03405 5C

SOCIETE DEGREMONT, RUEIL-MALMAISON (FRANCE).
How Pulsators and Superpulsators Can Improve the Water Treatment Process,
W83-03220 5F

SOUTH DAKOTA STATE UNIV., BROOKINGS. DEPT. OF AGRICULTURAL ENGINEERING.
Tillage and Irrigation Management Practices for Optimum Crop Production,
W83-03329 3F

SOUTH DAKOTA STATE UNIV., BROOKINGS. WATER RESOURCES RESEARCH INST.
Wind Energy for Low Head Irrigation,
W83-03309 8C

Optimum Irrigation Loading Rates of Highly Saline Wastewater on a Montmorillonitic Soil,
W83-03327 3C

SOUTH DAKOTA UNIV., VERMILLION. DEPT. OF BIOLOGY.
Efficiency of Water Use by Crops Under Allelopathy Stress,
W83-03313 2I

SOUTHERN ILLINOIS UNIV. AT EDWARDSVILLE. DEPT. OF BIOLOGICAL SCIENCES.
Post-Mining Neutralization of Acidic Surface Mine Lakes,
W83-03278 5B

SOUTHERN PIEDMONT CONSERVATION RESEARCH CENTER, WATKINSVILLE, GA.
Basin-Scale Evapotranspiration Determination through Watershed and Climate Analyses,
W83-03328 2D

STANFORD UNIV., CA. DEPT. OF ENVIRONMENTAL ENGINEERING.
Removal of Trace Chlorinated Organic Compounds by Activated Carbon and Fixed-Film Bacteria,
W83-03194 5D

STANFORD UNIV., CA. DEPT. OF OPERATIONS RESEARCH.
Multi-Purpose Storage Systems: Objective, Conflicts, Alternatives,
W83-03424 6A

VOOR BODEMKARTERING, WAGENINGEN (NETHERLANDS).DEPT. OF APPLIED

STICHTING VOOR BODEMKARTERING, WAGENINGEN (NETHERLANDS).DEPT. OF APPLIED SOIL PHYSICS.
Obtaining Soil Physical Field Data for Simulating Soil Moisture Regimes and Associated Potato Growth,
W83-03390 2G

STIRLING UNIV. (SCOTLAND). INST. OF AQUACULTURE.
An Evaluation of Proposed Cage Fish Culture on Loch Lomond, An Important Reservoir in Central Scotland,
W83-03403 6G

STUTTGART UNIV. (GERMANY, F.R.).
Hydraulic Criteria for the Design of Weir Sills (Hydraulische Entwurfs- Und Bemessungskriterien fur Sohlschwellen),
W83-03241 8B

Promising Experiments on Leak Location by Means of Correlation (Aussichtsreiche Versuche Zur Leckortung Mittels Korrelation),
W83-03445 5F

Energy Reclamation from the Drinking Water System with Series-Connected Pumps (Energieruckgewinnung Aus Dem Trinkwassersystem Mit Serienpumpen),
W83-03460 8C

SURREY DISTRICT, VANCOUVER (BRITISH COLUMBIA).
Water and Sewer System Modelling Using a Micro-Computer System,
W83-03243 5F

TECHNION - ISRAEL INST. OF TECH., HAIFA.
Evaluating the Release of Soluble Components from Sediment,
W83-03168 5B

TECHNISCHE UNIV., MUNICH (GERMANY, F.R.). INST. FUER HYDRAULIK UND GEWASSERKUNKE.
Inlet Construction for Vortex Drops With Supercritical Inflow (Einlaufkonstruktion Fur Wirbelfallschachte Mit Schiessendem Zufluss),
W83-03481 8B

TECHNISCHE UNIV., MUNICH (GERMANY, F.R.). LEHRSTUHL UND PRUEFAMT FUER WASSERGUTEWIRTSCHAFT UND GESUNDHEITSINGENIEURWESEN.
Obtaining Rainfall Intensity Curves from Munich Rainfall Records (Die Ermittlung Von Regenspendelinien Aus Munchner Regenschreiberaufzeichnungen),
W83-03452 2B

Automation in Wastewater Technology and Water Quality. Practical Experience with Control, Regulation, and Automation in Sewer Systems, Wastewater Treatment, and Water Quality Control (Automation in Der Abwassertechnik und Gewassergute. Praktische Erfahrungen Bei Der Steuerung, Regelung und Automation Bei Der Abwasserableitung, Abwasserbehandlung und Gewasserguteuberwachung,
W83-03469 5D

TENNESSEE UNIV., KNOXVILLE. DEPT. OF CIVIL ENGINEERING.
The Role of Cationic Surfactants in the Renovation of Water,
W83-03275 5F

TEXAS A AND M UNIV., COLLEGE STATION. WATER RESOURCES INST.
Assessment of Stormflow and Water Quality From Undisturbed and Site Prepared Forest Land in East Texas,
W83-03277 4C

TEXAS UNIV. AT AUSTIN.
Water-Its Role From Now to the Year 2000,
W83-03491 6D

TEXAS UNIV. AT AUSTIN. BUREAU OF ECONOMIC GEOLOGY.
Trans-Boundary Geothermal Resources of Texas and Mexico,
W83-03499 2F

TEXAS UNIV. AT AUSTIN. CENTER FOR RESEARCH IN WATER RESOURCES.
Anticipating Transboundary Water Needs and Issues in the Mexico-United States Border Region in the Rio Grande Basin,
W83-03495 6D

TEXAS UNIV. AT AUSTIN. DEPT. OF ENVIRONMENTAL ENGINEERING.
Surface Water Quality in the Border Area Between El Paso and the Gulf of Mexico,
W83-03500 5G

TEXAS UNIV. AT AUSTIN. SCHOOL OF LAW.
Texas Groundwater Law: A Survey and Some Proposals,
W83-03497 6E

THESSALONIKI UNIV., SALONIKA (GREECE).
A Method for Calculating the Dimensions of Long Sewage Force Mains,
W83-03199 5D

THESSALONIKI UNIV., SALONIKA (GREECE). POLLUTION CONTROL LAB.
Heavy Metals in Flowing Waters and River Sediments of the Western Harz Region (Schwermetalle in Den Fliessgewassern Und Flusssedimenten Des West-Harzes,
W83-03457 5B

TORONTO UNIV. (ONTARIO). DEPT. OF BOTANY.
Free Ionic Nickel Accumulation and Localization in the Freshwater Zooplankter, Daphnia Magna,
W83-03256 5B

TOURS UNIV. (FRANCE). LAB. DE CHIMIE MINERALE ET D'HYDROLOGIE.
Trace Toxic Metals Determination in Natural Waters Using X-Ray Fluorescence Spectrometry on a Chelating Resin Captor (Determination De Traces Metaux Toxiques Dans Les Eaux Naturelles Par Spectrometrie De Fluorescence X Sur Capteur De Resine Chelatante),
W83-03414 5A

UNIVERSITY COLL. OF NORTH WALES, MENAI BRIDGE. MARINE SCIENCE LABS.
A Seasonal Study of the Distributions of Surface State Variables in Liverpool Bay. III. An Offshore Front,
W83-03173 2L

UPPSALA UNIV. (SWEDEN). NATURGEOGRAFISKA INST.
Environmental Problems of Reservoir Development with Special Regard to Conditions in Sweden,
W83-03393 6G

UTAH STATE UNIV., LOGAN.
Fecal Coliform Release Studies and Development of a Preliminary Nonpoint Source Transport Model for Indicator Bacteria,
W83-03376 5B

UTAH WATER RESEARCH LAB., LOGAN.
An Experimental Investigation of the Effects of Crude Oil on Two Freshwater Lake Ecosystems,
W83-03273 5C

Index Construction for Multiple Objective Analysis of Land and Water Use in a High Mountain Watershed,
W83-03286 6A

Adapting Appropriation Water Law to Accommodate Equitable Consideration of Instream Flow Uses,
W83-03379 6E

UTRECHT RIJKSUNIVERSITEIT (NETHERLANDS). DEPT. OF LANDSCAPE ECOLOGY AND NATURE MANAGEMENT.
Sampling Macrofauna in Ditches,
W83-03217 7B

VALENCIA UNIV. (SPAIN). DEPT. OF MICROBIOLOGY.
Improved Salmonella Recovery from Moderate to Highly Polluted Waters,
W83-03164 5A

VEB BINNENFISCHEREI, WERMSDORF (GERMAN D.R.).
Efficient Utilization of Industrial Waster and Waste Heat for Intensive Fish Production (Die Rationelle Nutzung Von Industriewasser Und Abwarme Fur Eine Intensive Fischproduktion),
W83-03221 3C

VEB ZELLSTOFF- UND PAPIERFABRIK, ROSENTHAL (GERMAN D.R.).
Problems of the Load at Veb Zellstoff-Und Papierfabrik Rosenthal (Probleme Der Abwasserlast Im Veb Zellstoff-Und Papierfabrik Rosenthal),
W83-03223 5D

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
In Situ Nitrogen (C2H2) Fixation in Lakes of Southerm Victoria Land, Antarctica,
W83-03203 2H

The Effects of Altered Hydrologic Regime on Tree Growth Along the Missouri River in North Dakota,
W83-03262 6G

WAHNBACHTALSPERRENVERBAND, SIEGBURG (GERMANY, F.R.).
Development and Status of Emergency Drinking Water Supply in the Federal Republic of Germany After Passage of the Water Safeguarding Law (Entwicklung und Stand Der Tinkwasser-Notversorgung in Der Bundesrepublik Nach Dem Wassersicherstellungsgesetz),
W83-03458 5F

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF AGRICULTURAL ENGINEERING.
Surface Irrigation as Affected by Ash from Mount St. Helens,
W83-03285 2J

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Water Quality of the Upper Spokane River and Evaluation of Methods for Measurement of the Effect of Effluent Upon Primary and Secondary Producers,
W83-03317 5A

WASHINGTON UNIV., SEATTLE. OFFICE OF PUBLIC ARCHAEOLOGY.
Control of Algal Dominance Through Changes in Zooplankton Grazing, Lake Washington: Phase I,
W83-03467 5G

WATER AND POWER RESOURCES SERVICE, SACRAMENTO, CA. MID-PACIFIC REGION.
Soil Collapses on Shores of Clear Lake Reservoir, Modoc County, California,
W83-03189 8A

WATER RESEARCH CENTRE, MARLOW (ENGLAND).
Accuracy of Determination of Total Oxidised Nitrogen and Nitrite in River Waters: Analytical Quality Control in the Harmonised Monitoring Scheme.
W83-03207 5A

WESSEX WATER AUTHORITY, POOLE (ENGLAND). DIVISIONAL MICROBIOLOGY LAB.
Applications of a Serratia Marcescens Bacteriophage as a New Microbial Tracer of Aqueous Environments,
W83-03165 5B

WESTERN AUSTRALIA DEPT. OF CONSERVATION AND ENVIRONMENT, PERTH.
Lead and Other Trace Metals in the Sediments and Selected Biota of Princess Royal Harbour, Albany, Western Australia,
W83-03399 5B

WISCONSIN UNIV.-MADISON. DEPT. OF GEOLOGY AND GEOPHYSICS.
The Groundwater Budget of Lake Wingra, Dane County, Wisconsin,
W83-03305 2F

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF ATMOSPHERIC SCIENCES.
Numerical Simulation of Land-Breeze-Induced Snowbands Along the Western Shore of Lake Michigan,
W83-03482 2C

WISCONSIN UNIV.-STEVENS POINT. COLL. OF NATURAL RESOURCES.
Effects of Silvicultural Practices on Water Quality in Northern Wisconsin,
W83-03304 5G

WROCLAW TECHNICAL UNIV. (POLAND). INST. OF ENVIRONMENTAL ENGINEERING.
Factors Influencing Hourly and Daily Water Demand (Uber Die Stunden-Und Tagewasserbedarf Beeinflussenden Faktoren),
W83-03438 6D

YORKSHIRE WATER AUTHORITY (ENGLAND).
Fit to Drink,
W83-03236 5F

ZWECKVERBAND FERNWASSERVERSORGUN RHEINTAL, SINSHEIM (GERMANY, F.R.).
Forecasting Methods in the Future Supply Area of the Rheintal Water Transmission Network (Beweissicherungsverfahren Im Kunftigen Wassergewinnungsgebiet Des Zweckverbands Fernwasserversorgung Rheintal (FWR),
W83-03456 3F

ACCESSION NUMBER INDEX

W83-03151 5D
W83-03152 5D
W83-03153 5G
W83-03154 5D
W83-03155 5B
W83-03156 5B
W83-03157 5F
W83-03158 2J
W83-03159 2L
W83-03160 2H
W83-03161 4D
W83-03162 4A
W83-03163 4A
W83-03164 5A
W83-03165 5B
W83-03166 4A
W83-03167 5G
W83-03168 5B
W83-03169 2L
W83-03170 5B
W83-03171 2H
W83-03172 5G
W83-03173 2L
W83-03174 4D
W83-03175 6D
W83-03176 5G
W83-03177 5A
W83-03178 3E
W83-03179 3A
W83-03180 2H
W83-03181 2L
W83-03182 5B
W83-03183 2L
W83-03184 6A
W83-03185 5A
W83-03186 5B
W83-03187 5A
W83-03188 8B
W83-03189 8A
W83-03190 5A
W83-03191 5D
W83-03192 6G
W83-03193 5B
W83-03194 5D
W83-03195 5C
W83-03196 5D
W83-03197 8D
W83-03198 8A
W83-03199 5D
W83-03200 5G
W83-03201 2K
W83-03202 2L
W83-03203 2H
W83-03204 2J
W83-03205 5F
W83-03206 5A
W83-03207 5A
W83-03208 2F
W83-03209 2K
W83-03210 5B
W83-03211 6A
W83-03212 6G
W83-03213 5B
W83-03214 5C
W83-03215 5C
W83-03216 5C
W83-03217 7B
W83-03218 8D
W83-03219 5F
W83-03220 5F
W83-03221 3C
W83-03222 5D
W83-03223 5D
W83-03224 6A
W83-03225 7B
W83-03226 5F
W83-03227 5F
W83-03228 5F
W83-03229 5F
W83-03230 8B
W83-03231 5D
W83-03232 8C
W83-03233 6E
W83-03234 5D
W83-03235 5D
W83-03236 5F
W83-03237 5B
W83-03238 4A
W83-03239 7B
W83-03240 7B
W83-03241 8B
W83-03242 7B
W83-03243 5F
W83-03244 5F
W83-03245 5F
W83-03246 5F
W83-03247 8B
W83-03248 8A
W83-03249 8C
W83-03250 8G
W83-03251 6G
W83-03252 5D
W83-03253 8A
W83-03254 2H
W83-03255 5C
W83-03256 5B
W83-03257 2L
W83-03258 8C
W83-03259 1A
W83-03260 2H
W83-03261 2L
W83-03262 6G
W83-03263 2H
W83-03264 2L
W83-03265 4B
W83-03266 5B
W83-03267 5B
W83-03268 5D
W83-03269 4D
W83-03270 6B
W83-03271 2E
W83-03272 5E
W83-03273 5C
W83-03274 6E
W83-03275 5F
W83-03276 5B
W83-03277 4C
W83-03278 5B
W83-03279 5G
W83-03280 6A
W83-03281 3F
W83-03282 6D
W83-03283 2F
W83-03284 3C
W83-03285 2J
W83-03286 6A
W83-03287 4D
W83-03288 3A
W83-03289 5B
W83-03290 5F
W83-03291 5A
W83-03292 5A
W83-03293 2A
W83-03294 2E
W83-03295 2A
W83-03296 4A
W83-03297 2B
W83-03298 2J
W83-03299 5G
W83-03300 5C
W83-03301 5B
W83-03302 6D
W83-03303 6D
W83-03304 5G
W83-03305 2F
W83-03306 5A
W83-03307 5C
W83-03308 2K
W83-03309 8C
W83-03310 7A
W83-03311 5C
W83-03312 2D
W83-03313 2I
W83-03314 5C
W83-03315 5B
W83-03316 3A
W83-03317 5A
W83-03318 8I
W83-03319 2G
W83-03320 6E
W83-03321 4B
W83-03322 5B
W83-03323 4A
W83-03324 6F
W83-03325 6G
W83-03326 6A
W83-03327 3C
W83-03328 2D
W83-03329 3F
W83-03330 6D
W83-03331 4D
W83-03332 5C
W83-03333 7B
W83-03334 7A
W83-03335 2E
W83-03336 6C
W83-03337 5F
W83-03338 5F
W83-03339 2B
W83-03340 5E
W83-03341 3A
W83-03342 3F
W83-03343 6B
W83-03344 5B
W83-03345 6B
W83-03346 5F
W83-03347 2H
W83-03348 2K
W83-03349 6A
W83-03350 4A
W83-03351 3D
W83-03352 3A
W83-03353 5B
W83-03354 6E
W83-03355 7C
W83-03356 4D
W83-03357 2E
W83-03358 2C
W83-03359 2K
W83-03360 2K
W83-03361 2K
W83-03362 7C
W83-03363 2L
W83-03364 5B
W83-03365 5B
W83-03366 2E
W83-03367 6D
W83-03368 2J
W83-03369 7B
W83-03370 2H
W83-03371 5C
W83-03372 2I
W83-03373 5F
W83-03374 8B
W83-03375 5A
W83-03376 5B
W83-03377 6G
W83-03378 3C
W83-03379 6E
W83-03380 2F
W83-03381 2L
W83-03382 2K
W83-03383 3F
W83-03384 3F
W83-03385 5B
W83-03386 5C
W83-03387 4A
W83-03388 3C
W83-03389 2D
W83-03390 2G
W83-03391 3C
W83-03392 5A
W83-03393 6G
W83-03394 6G
W83-03395 2C
W83-03396 5A
W83-03397 5B
W83-03398 5B
W83-03399 5B
W83-03400 5A
W83-03401 5A
W83-03402 5B
W83-03403 6G
W83-03404 3A
W83-03405 5C
W83-03406 5E
W83-03407 5A
W83-03408 3F
W83-03409 7B
W83-03410 3F
W83-03411 5F
W83-03412 5A
W83-03413 5A
W83-03414 5A
W83-03415 5A
W83-03416 2K
W83-03417 2J
W83-03418 6A
W83-03419 6G
W83-03420 6G
W83-03421 6G
W83-03422 5G
W83-03423 6D
W83-03424 6A
W83-03425 6D
W83-03426 8A
W83-03427 5B
W83-03428 5A
W83-03429 5C
W83-03430 5F
W83-03431 4B
W83-03432 5B
W83-03433 4A
W83-03434 2K
W83-03435 5D
W83-03436 5D
W83-03437 5D
W83-03438 6D
W83-03439 5F
W83-03440 5D
W83-03441 6E
W83-03442 5A
W83-03443 5D
W83-03444 5D
W83-03445 5F
W83-03446 5B
W83-03447 2F
W83-03448 2F
W83-03449 5F
W83-03450 2L
W83-03451 2L
W83-03452 2B
W83-03453 2A
W83-03454 5C
W83-03455 5F
W83-03456 3F
W83-03457 5B
W83-03458 5F
W83-03459 8A
W83-03460 8C
W83-03461 2A
W83-03462 3A
W83-03463 5C
W83-03464 4B
W83-03465 2A
W83-03466 3B
W83-03467 5G
W83-03468 3A
W83-03469 5D
W83-03470 5B
W83-03471 5F
W83-03472 2H
W83-03473 5C
W83-03474 5C
W83-03475 5C
W83-03476 5F
W83-03477 5F
W83-03478 2H
W83-03479 2H
W83-03480 6G
W83-03481 8B
W83-03482 2C
W83-03483 5B
W83-03484 5B
W83-03485 5A
W83-03486 2A

W83-03487 7B
W83-03488 3F
W83-03489 6G
W83-03490 5A
W83-03491 6D
W83-03492 6E
W83-03493 6D
W83-03494 2J
W83-03495 6D
W83-03496 6E
W83-03497 6E
W83-03498 6E
W83-03499 2F
W83-03500 5G

Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

- SUBJECT INDEX
- AUTHOR INDEX
- ORGANIZATIONAL INDEX
- ACCESSSION NUMBER INDEX

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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 16, NUMBER 11
NOVEMBER 1983

W83-03501 -- W83-03850
CODEN: SWRABW

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 16, NUMBER 11
NOVEMBER 1983

W83-03501 -- W83-03850

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Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
Reston, VA 22092

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

SECOND ROW MOLECULAR ORBITAL CALCULATIONS. 5. A MINIMAL BASIS INDO FOR NA-CL,
North Dakota State Univ., Fargo. Dept. of Chemistry.
M. S. Gordon, M. D. Bjorke, F. J. Marsh, and M. S. Korth.
Water Resources Research Institute Completion Report, North Dakota State University, Fargo, January 1983. 9 p, 5 Fig, 18 Tab, 18 Ref. OWRT A-045-NDAK(2), 14-34-0001-7071.

Descriptors: *Bonding, *Barriers, Theoretical analysis, Model studies, *Sodium Chloride, *Molecular structure.

An INDO method is developed for molecules containing Na-CL. Using only valence s and p orbitals, the parametrization is carried out in the spirit of the approach originally taken by Pople and coworkers. The reliability of the method is tested by calculating geometries, dipole moments, and internal rotation barriers for approximately 100 molecules. The improvement in predictive ability relative to previous parametrizations is considerable. Predicted geometries are nearly as good as those for STO3G. Dipole moments of molecules containing Si and Cl are in excellent agreement with experiment, while for P and S the agreement is only fair. This simple parametrized model provides accurate results with little use of computer time and allow calculations of properties of dissolved constituents to be made .
W83-03613

2. WATER CYCLE

2A. General

CURRENTS IN SOUTH SAN FRANCISCO BAY,
California Univ., Berkeley. Hydraulic Engineering Lab.
For primary bibliographic entry see Field 5B.
W83-03690

WATER CONSERVATION AND GROUNDWATER RECHARGE ON EASTERN LONG ISLAND,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W83-03703

A PARAMETRIC MODEL FOR PEAK FLOW PREDICTION IN UNGAGED EPHEMERAL WATERSHEDS,
Nevada Univ. System, Reno. Desert Research Inst.
A. D. Truschel, and M. E. Campana.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249698, Price codes: A06 in paper copy, A01 in microfiche. Publication No 41083, July 1983. 108 p, 30 Fig, 9 Tab, 46 Ref. 2 Append. OWRT B-122-NEV(1), 14-34-0001-0232.

Descriptors: *Parametric hydrology, *Flood peak, *Ephemeral streams, Quasi-linear spatially-distributed cell model, *Arid-zone hydrology, Watershed management, Oklahoma, Texas, Arizona, Storm runoff, Model studies.

The prediction of peak flows from ungaged ephemeral watersheds is an important aspect of arid zone engineering hydrology. Sophisticated physically based models are currently available for the estimation of peak flows; however, these models can be difficult to use and generally require detailed information on watershed properties. Parametric runoff models, while lacking complexity, require large amounts of historical rainfall-runoff data for calibration, data that are unavailable in ungaged watersheds. To overcome these difficulties, a physically based model of an ephemeral watershed was used to generate synthetic calibration data. These data were then used to calibrate a special type of parametric model, a quasi-linear spatially-distributed cell model. Prior to calibration, an optimum-sized unit area (cell size) was determined for the cell model. The calibration phase consisted of developing relations between the cell storage constants of the parametric model and combinations of the influential hydraulic parameters of the physically based model. Since the latters's parameters represent measurable watershed properties, the relations can then be used to apply the cell model directly to ungaged watersheds. The calibration method was validated by applying it to 53 storm runoff events from ephemeral watersheds in Oklahoma, Texas and Arizona. Peak runoff rates predicted by the cell model showed poor correlation with actual rates. Primary reasons for the poor correlation can be attributed to the lack of spatially-distributed rainfall inputs, the failure to consider spatial variance in infiltration properties during calibration and a failure to consider channel transmission losses explicitly in the cell model.
W83-03778

OCCURRENCE PROBABILITIES OF ANTECEDENT MOISTURE CONDITION CLASSES IN INDIANA,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
D. D. Gray, and C. B. Burke.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-253302, Price codes: A06 in paper copy, A01 in microfiche. Technical Report No 159, June 1983. 97 p, 24 Fig, 23 Tab, 28 Ref, 3 Append. OWRT A-060-IND(2).

Descriptors: *Antecedent moisture, Soil water, Rainfall infiltration, *Rainfall-runoff relationships, Excess rainfall, *Computer programs, Model studies, *Indiana.

Discrete Antecedent Moisture Condition (AMC) classes are the simplest means to account for the influence of initial watershed moisture on runoff. AMC classes are used to adjust the abstraction parameters in two widely used hydrologic models: the Soil Conservation Service Curve Number method and the Illinois Urban Drainage Area Simulator computer program (ILLUDAS). In this report, a total of 258 years of daily weather observations at 10 Indiana stations has been used to estimate the seasonal and monthly occurrence probabilities of the Curve Number and ILLUDAS AMC classes. Similar results can now be obtained for any location in Indiana by interpolation. This information will provide guidance to hydrologists who must postulate an AMC class for use in design calculations. The methodology of this study is explained and justified. A listing of the computer program used to analyze the data is included. Shortcomings of the present AMC criteria are discussed, and the results of certain possible modifications are presented. Cumulative Distribution Functions of 5-day antecedent rainfall are tabulated so that future researchers can investigate alternative criteria without having to reanalyze the original data.
W83-03818

RELATIONSHIPS AMONG PRECIPITATION, SNOWMELT, SUBSURFACE FLOW, GROUNDWATER RECHARGE, AND STREAMFLOW GENERATION IN THE CLEAR CREEK WATERSHED, EASTERN SIERRA NEVADA,
Nevada Univ. System, Reno. Desert Research Inst.
R. L. Boone, M. E. Campana, and C. M. Skau.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-253344, Price codes: A07 in paper copy, A01 in microfiche. Publication No 41084, July 1983. 113 p, 40 Fig, 6 Tab, 94 Ref, 4 Append. A-089-NEV(1), 14-34-0001-9030.

Descriptors: *Groundwater recharge, Hillslope hydrology, *Subsurface flow, *Snowmelt, Tensiometers, Piezometers, Soil moisture, Soil temperature, *Nevada, Clear Creek watershed, Sierra Nevada, Forest watersheds, *Surface-groundwater relations, *Precipitation.

An understanding of hillslope hydrologic processes in the forested watersheds of the Sierra Nevada is requisite to the quantification of water quality, groundwater recharge and streamflow generation. A field study utilizing a tensiometer-transducer network, piezometers, psychrometers and flumes was initiated in a portion of the Clear Creek watershed in the Carson Range of the Sierra Nevada. The investigation sought to examine the relationships among precipitation, snowmelt, groundwater recharge, subsurface flow and streamflow generation during the fall of 1982 and the winter of 1983 as well as provide a benchmark for future similar studies in the Sierra. No significant subsurface stormflow was observed during the study period, although this would undoubtedly contribute to streamflow during spring snowmelt season. Snowmelt at the snow/ground interface was absent during the winter, although soil thermal gradients were sufficient to prevent soil freezing. Deep percolation (potential groundwater recharge), derived from the snowpack, occurred continuously during November through mid-Friday at two locations. Additional pulses of deep percolation from rain/snow events in December and January were superimposed over the existing downward flow field in the soil. The local groundwater system may also derive recharge from higher zones in the watershed, where soils are thinner. The deeper portion of the groundwater system may be linked to a joint system in the study area.
W83-03822

AGRO-ECOLOGICAL REGIONS OF WESTERN RAJASTHAN,
Central Arid Zone Research Inst., Jodhpur (India). Div. of Basic Resources Studies.
A. K. Sen, and K. N. Gupta.
Journal of Arid Environments, Vol 5, No 3, p 221-234, 1982. 6 Fig, 9 Tab, 21 Ref.

Descriptors: *Arid lands, *Agricultural hydrology, *Mapping, Groundwater, Crop yields, Soil properties, Topography, Semiarid lands, Deserts, Climates, Drainage, Rajasthan, *India.

The agro-ecological regions of western Rajasthan were classified and mapped. The quantitative relationship between agricultural characteristics and environmental factors in the arid zone was determined by close examination of three variables: topoclimatology, including local climate, topography, drainage, ground water and soils; cropping patterns, including the delineation of the area of one crop or a related group of crops; and agrodemography. These variables were used to generate a variety of indices, which in turn formed the basis for subdivision of the area into agro-ecological zones. Based on the relationships between these indices, the region has been mapped into two macro- and four micro-agro-ecological units. These mapping units are of homogeneous agricultural fitness. Finally, the characteristics and agricultural peculiarities of the regions as reflected by topoclimatology including soil, ground water, cropping pattern, crop yields, agrodemographic and agro-economic aspects are considered. (Baker-FRC)
W83-03850

2B. Precipitation

ON THE ROLE OF LARGE SCALE ENERGETICS IN THE ONSET AND MAINTENANCE OF SUMMER MONSOON--II: MOISTURE BUDGET,
Indian Inst. of Tech., New Delhi. Centre for Atmospheric and Fluids Sciences.
U. C. Mohanty, S. K. Dube, and P. C. Sinha.
Mausam, Vol 33, No 3, p 285-294, July , 1982. 6 Fig, 7 Ref.

Descriptors: *Monsoons, *Heat balance, *Hydrometeorology, Rainfall, *India, Climatology, Moisture, Latent heat, Tropical regions, Precipitation, Potential rainfall.

The moisture and moist static energy budget over a large monsoon area from 20 degrees S to 40 degrees N and 0 degrees E to 150 degrees E in May-July 1979 were studied with the help of a reliable, complete data set, which consisted of twice daily First GARP Global Experiment level IIIb analysis temperature, relative humidity, geopotential and wind fields. The daily variation of latent heat energy increased from May 4 to June 5. The horizontal import and diabatic sink increased from June 3-6 and remained high until July 3. These characteristic indicators of monsoon activities were evident 2 weeks before the onset of the monsoon over the Kerala coast and remained high during the active monsoon period. After July 5 there was a net transport of moisture from the region, indicating a weakening of the monsoon about 10 days before the break monsoon prevailed (in 1979 on July 16). Daily variation in the moisture budget parameters were also reliable indicators of monsoon activity over India. The net moist static energy remained almost steady for the entire period. Daily variation of the moist static energy budget parameters did not show any trends. (Cassar-FRC)
W83-03786

AN ANALYSIS OF MAURITIAN WINTER RAINFALL,
Meteorological Service, Vacoas (Mauritius).
B. M. R. Pathack.
Mausam, Vol 33, No 3, p 361-372, July, 1982. 5 Fig, 3 Tab, 15 Ref.

Descriptors: *Rainfall distribution, *Seasonal variation, *Tropical regions, *Mauritius, Statistical analysis, Spectral analysis, Precipitation.

Long-term winter rainfall records (100 years) for the island of Mauritius were examined by statistical and spectral analysis. The cyclone-free months of June-August were considered. Drier areas were more variable in rainfall. Significant peaks of 10-13 years were thought to be associated with the solar cycle. Less pronounced peaks were seen for 2, 3-4, and 16-20 year periods. Wet winters were recorded in 1885, 1909, 1926-27, 1939-40, 1951-54, 1961-62, and 1972. Dry winters were recorded in 1883-84, 1886, 1902-03, 1915-16, 1921-23, 1942-48, and 1956-57. Data contained spectral peaks, but very few were significant. (Cassar-FRC)
W83-03787

HYDROMETEOROLOGICAL STUDY OF SEVERE RAINSTORMS OF NORTH BIHAR,
Meteorological Office, Patna (India).
A. K. Ghosh, and K. Prasad.
Mausam, Vol 33, No 3, p 385-390, July, 1982. 4 Fig, 2 Tab, 6 Ref.

Descriptors: *Rainstorms, *Monsoons, *Hydrometeorology, Bihar, *India, Ganges River, Rainfall distribution, Precipitation, Storms, Flood forecasting.

A hydrometeorological analysis of severe rainstorms of the north Bihar region in India (Gandak, Burhi Bandak, Bagmati, Adhwara, and Kamala catchments, all draining into the Ganges River) shows that most severe storms occur in September. These rainstorms are mostly associated with monsoon depressions and low pressure areas. During September the heavy rainfall centers lie mostly in front and to the right of the track of the pressure systems. The bearings of the heavy rain centers relative to storm tracks range from -45 degrees to +95 degrees. The distances of these centers from the center of the pressure systems range between 110 and 520 km. (Cassar-FRC)
W83-03788

PROBABILIITY ANALYSIS OF SHORT PERIOD RAINFALL IN DRY FARMING TRACT IN INDIA,
Meteorological Office, Poona (India).
R. P. Sarker, B. C. Biswas, and N. N. Khambete.
Mausam, Vol 33, No 3, p 269-284, July, 1982. 12 Fig, 6 Tab, 8 Ref.

Descriptors: *Dry farming, *Rainfall distribution, Precipitation, *India, Monsoons, Areal precipitation, Agriculture.

Minimum assured rainfall has been calculated for probability levels from 10 to 90% for the dry farming region in India, 87 districts in 9 states. Rainfall, annually 400-1000 mm, is the limiting factor in agriculture. The number of rainy days per year ranges from 19 to 61. Seven homogeneous rainfall zones were identified to help in effluent agricultural planning. In some regions a kharif crop is impractical, but prospects for rabi crops are fairly good. Monsoon activity is lowest throughout the entire dry farming tract during weeks 32 to 34. Kharif crop prospects are very good in a high rainfall belt in the eastern part of the tract between 18-23 degrees north latitude and east of 75 degrees longitude. Knowing the assured rainfall distribution for the major areas, the specific cropping patterns for local areas can be further refined by consideration of soil characteristics and evapotranspiration demands. (Cassar-FRC)
W83-03800

PATH OF A VORTEX IN A SEMI-INFINITE REGION WITH A STREAMING MOTION ALONG A PLANE WALL BOUNDARY HAVING A SEMICIRCULAR BAY OR BULGE,
Meteorological Office, Calcutta (India).
For primary bibliographic entry see Field 2E.
W83-03807

2D. Evaporation and Transpiration

WATER-USE PRODUCTION FUNCTIONS OF SELECTED AGRONOMIC CROPS IN NORTHWESTERN NEW MEXICO, PHASE II,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
C. E. Kallsen, E. J. Gregory, and T. W. Sammis.
New Mexico WRRI Report No 155, October 1982. 130 p, 29 Fig, 43 Tab, 25 Ref, 7 Append.

Descriptors: *Water use efficiency, *Soil-water-plant relationships, *Evapotranspiration, *Crop production, *Transpiration, Barley, Beans, Alfalfa, Economic yield, Evapotranspiration control, Evapotranspiration potential, Seasonal variation, Irrigation, *New Mexico.

The water requirement for growth of spring barley, pinto beans, and alfalfa was investigated in northwestern New Mexico. Results strongly suggest that the level of nitrogen fertility does not alter the water-use efficiency (WUE) of spring barley when WUE is expressed as a function of transpiration. WUE may change, depending on irrigation scheduling, if WUE is expressed as a function of evapotranspiration. The difference is attributed to differential soil-water evaporation. Further evidence supports the hypothesis that a common function exists independent of season, with respect to a given crop, relating economic yield to transpiration. Crop coefficients based on various methods of calculating potential evapotranspiration were found to vary as much as 50% between years due in part to the difference in the evaporation component of the measured evapotranspiration. Although the study was unable to determine the effect of nitrogen fertility on pinto beans, the spring barley data suggest that nitrogen fertility does not affect the WUE when the efficiency is expressed as the weight of economic yield produced per depth of water transpired. The value of the potential evapotranspiration measurement for predicting the crop evapotranspiration requirement is seriously questioned by the date produced. Caution should be exercised in using crop coefficients to predict alfalfa, pinto beans, and spring barley seasonal or intraseasonal water requirements when the crops are grown under conditions requiring frequent light irrigation. (Garrison-Omniplan)
W83-03560

EVAPOTRANSPIRATION FROM HETEROGENEOUS MOUNTAIN MEADOWS,
Wyoming Univ., Laramie. Coll. of Agriculture.
J. Borrelli, and R. D. Burman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246397, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Series No 86, Water Research Center, July 1982. 35 p, 2 Fig, 8 Tab, 1 App, 10 Ref. OWRT A-026-WYO(1), 14-34-0001-9054.

Descriptors: Irrigation requirements, Crop production, Meadows, Return flow, *Evapotranspiration, Grasses, Lysimeters, *Little Laramie River Valley, *Wyoming, *Blaney-Criddle method, Mountain meadows.

The evapotranspiration rates of irrigated mountain meadow grasses were measured using non-weighing lysimeters during the 1979 and 1980 growing seasons. The lysimeters were located in a line across the Little Laramie River Valley near Laramie, Wyoming. The 1967 version of the Blaney-Criddle method for estimating evapotranspiration was calibrated using the lysimeter data (USDA, SCS, 1967). Lysimeters 1, 2, 3, 8, and 9 were located in areas that were not irrigated. However the E sub t rates measured by lysimeters 2, 3, and 9 were as great as E sub t rates measured by lysimeters in the irrigated portion of the mountain meadows. The high water table in these non-irrigated areas provided an extra source of water. The return flows from irrigated areas appeared to provide the bulk of the groundwater.
W83-03684

A 'MICRO-LYSIMTER' METHOD FOR DETERMINING EVAPORATION FROM BARE SOIL: DESCRIPTION AND LABORATORY EVALUATION,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
C. W. Boast, and T. M. Robertson.
Soil Science Society of America Journal, Vol 46, No 4, p 689-696, July/August, 1982. 8 Fig, 1 Tab, 16 ref.

Descriptors: *Evaporation, *Measuring instruments, *Lysimeters, Soil moisture availability, Soil water, Water balance.

A micro-lysimeter approach is developed which avoids some of the problems of perturbed lower boundary conditions and some of the problems inherent in the construction of large lysimeters. This new method estimates evaporation from soil and consists of pushing a thin-walled cylinder 76 mm in diameter into field soil, removing the soil-filled cylinder from the field, closing the bottom to make it water-tight, determining the mass of the microlysimeter, replacing it in the field with its top surface even with the surrounding soil, leaving it exposed to environmental conditions for a period of time and redetermining its mass. Evaporation loss from the micro-lysimeter is the difference between the two masses. The method requires very little equipment, although it is labor-intensive. Evaporation can be determined under circumstances where traditional methods are impractical or impossible. For example micro-lysimeters can be used at a large number of locations for just a few days, where the cost of larger lysimeters would be prohibitive. Evaporation can be measured as a function of distance from a crop row, under conditions of partial cover and partial shading, or in other situations for which the spatial resolution of traditional lysimeters is too large. (Baker-FRC)
W83-03783

2E. Streamflow and Runoff

DIRECT MEASUREMENTS OF SECONDARY CURRENTS IN NATURAL MEANDER (DIREKTMESSUNG VON SEKUNDARSTROMUNGEN IN NATUERLICHEN MAANDERN),
C. Thorne, J. Bathurst, and R. Hey.
Wasserwirtschaft, Vol 71, No 10, p 283-288, October, 1981. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Rivers, *Meanders, *Flow velocity, *Water currents, *Field tests, Natural flow, Water circulation, Flow, Flow discharge, Flow rates,

Mathematical equations, Federal Republic of Germany.

Field measurements of secondary and primary velocities at a river meander are presented. At a bend, these illustrate the existance of a main secondary circulation cell which carries surface water towards the outer bank and bed water towards the inner bank. At the inflection plant between bends the data indicates that the main cell for the downstream bend originates at the bed and develops upward, thereby displacing the relic main cell of the upstream bend. Measurements at different discharges indicate that secondary circulation has less effect on flow hydraulics at high discharges than at medium discharges. At bends, the secondary circulation distorts the distributions of velocity and boundary shear stress, particularly close to the outer bank. This must be taken into account in bank protection and river training schemes. (Author's abstract)
W83-03525

REGIONAL FLOOD FREQUENCY ANALYSIS FOR ALASKA,
Alaska Univ., Fairbanks. Inst. of Water Resources.
J. R. Janowicz, and D. L. Kane.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235531, Price codes: A03 in paper copy, A01 in microfiche. Completion Report IWR-105, March 1983. 44 p, 16 Fig, 2 Tab, 39 Ref. OWRT A-071-ALAS(1), 14-34-0001-2101.

Descriptors: *Peak flow, Modeling, *Flood frequency, *Ungaged watersheds, Hydrologic data, *Alaska, Regional analysis, Design flow.

The objective was to develop a technique for determining peak design flows from ungaged watersheds throughout the state. First, the state was divided into six hydrologic units based on physiography, climate, and patterns of runoff. These were reduced to three hydrologic regions using multiple discriminate analysis. The lack of data in the northern and western parts of the state made it statistically impossible to separate out these hydrologic areas. Four theoretical probability distributions were fit to sample data reported by the U.S. Geological Survey, Water Resources Division. Only data with at least five years of record were used. Using the developed goodness of fit criteria, the 2-parameter log normal distribution was shown to fit the sample data better than the other methods. From flood frequency analysis, regional envelope curves were developed for selected return periods. A similar exercise was carried out for maximum observed flows to give an indication of upper flood limits. Finally, dimensionless frequency curves were developed for three hydrologic regions. These curves can be used to provide conservative estimates of flows for three hydrologic areas.
W83-03611

A STUDY OF LOW FLOWS USING DATA FROM THE SEVERN AND TRENT CATCHMENTS. PART II: FLOW FREQUENCY PROCEDURES,
J. Pirt, and C. M. Simpson.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 6, p 459-469, December, 1982. 5 Fig, 4 Tab, 13 Ref.

Descriptors: *Low flow, *River flow, *Drought, Flow characteristics, Severn River, Trent River, *United Kingdom, Streamflow forecasting, Flow frequency curves.

Low flows in ungaged regions of the Severn and Trent catchments were estimated by preparing flow frequency curves from data from 11 gaging stations. Data fitted a Gumbel type 1 distribution. Zero flow for each catchment was obtained at a return period of about 200 years. The average of the annual series of the minimum weekly flows had a return period of 2.33 years. The return period of the minimum 7-day flows as determined from the distribution was 19-38 years, average 23 years. This minimum flow was experienced in the drought of 1976. Independent variables in a stepwise linear regression were a permeability index, ageological index, stream frequency, dry weather flow yield, surface deposit index, mean annual effective precipitation, average catchment altitude, and stream slope. Application of the flow frequency curves to 6 other catchments showed that the method was more reliable than previous methods. (Cassar-FRC)
W83-03656

INSTREAM FLOW REQUIREMENTS FOR FISH AND FISHERIES IN MARYLAND,
Maryland Univ., Solomons. Chesapeake Biological Lab.
C. F. Tsai, and M. L. Wiley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249672, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report Univ. of Maryland, College Park, June 1983. 90 p, 21 Fig, 10 Tab, 47 Ref. OWRT B-038-MD(1), 14-34-0001-0266.

Descriptors: Piedmont streams, Hydraulic characteristics, volume flow, *Instream flow, Piedmont fishes, Species, Diversity, Fish abundance, Fish biomass, *Maryland, Fisheries, Low flow.

Fishes in Piedmont streams of Maryland were captured by electroshocker during low flow conditions to allow estimates to be made of minimum flow needed to sustain fish populations and communities. Hydraulic characteristics (area, width, depth, water velocity) were linearly correlated with volflo (volume flow). Diversity (H) of the fish community formed a hyperbolic function with volflo, the infection occurring near H = 1.03 and a volflo of 3 cfs (cubic feet per second). Both numerical abundance and biomass of fish per unit of volflo gave negative linear correlations with volflo. Total number of fish in a 400-ft stream section and volflo were curvilinearly related (second degree polynomial), with a peak of 734 fish at 2.48 cfs volflo, but total weight of fish increased linearly with volflo, suggesting that above 2.48 cfs volflo that fish became less numerous but larger in size. Each species had minimum volflo requirements and this made it difficult to establish minimum volflo criteria that were suitable for all species. The number of species per unit of volflo increased to a maximum of 25 species at 3 cfs volflo, which is close to 2.48 cfs, the value at which total abundance and species diversity were greatest and the species composition shifted from small headwater species to large river species. Therfore, 3 cfs volume flow (equivalent to a stream width of 13.9 feet at riffles and 17.8 feet at pools) may be considered as the minimum for fishes during low flow conditions in Piedmont streams of Maryland.
W83-03776

PATH OF A VORTEX IN A SEMI-INFINITE REGION WITH A STREAMING MOTION ALONG A PLANE WALL BOUNDARY HAVING A SEMICIRCULAR BAY OR BULGE,
Meteorological Office, Calcutta (India).
J. C. Mandal.
Mausam, Vol 31, No 1, p 101-110, January, 1980. 14 Fig, 6 Ref.

Descriptors: *Vortices, *Streamflow, *Mathematical models, Model studies, Mathematical equations, Eddies, Flow, Multiphase flow.

An attempt is reported to study the motion of a vortex in a two dimensional steady flow in presence of a plane wall with a semi-circular bay or bulge. This problem has applications in both hydrologic and atmospheric contexts. The technique of transformation has been used to study the problem. The stagnation points determined from both the graphical and analytical methods have been found to agree with each other. The problems arising in the presence of more than one vortex can be solved by the method presented. Since this paper deals with the motion of a vortex in a perfect fluid and in a two-dimensional uniform stream, it has limitations when applied to natural atmospheric vortices, where the effect of friction and the variation of strength of the vortex with height are to be considered and where the stream in which it is embedded is not uniform, However, the orographical effect on the motion of vortexes as found here may be helpful in practical cases. (Baker-FRC)
W83-03807

A SEVERE FLOOD IN LUNI BASIN, WESTERN RAJASTHAN DURING JULY 1979--A CASE STUDY,
Central Arid Zone Research Inst., Jodhpur (India).
K. D. Sharma, N. S. Vangani, P. C. Chatterji, and G. Singh.
Mausam, Vol 33, No 3, p 377-384, July, 1982. 5 Fig, 4 Tab, 5 Ref.

Descriptors: *Flood data, *Monsoons, *Rainfall distribution, Rajasthan, Luni River, *India, Historic floods, Flood spreading, Sediment transport.

In July 1979 a flood devastating to agricultural fields, irrigation projects, and other property occurred in the Luni River basin, western Rajasthan, India. Several factors contributed to the severity of the flood. Heavy to very heavy monsoon rains persisted over the region from July 15 to 19, releasing 11.7 billion cu m of water and flooding 20% of the 34,866 sq km basin. Heaviest rains were in the northeast where 700-900 mm of rain fell during the 5 days. The entire basin is composed of impervious rock formations underlying thin layers of alluvium (1-4 m). A peculiarity of this year system is its tendency for floods to expand and disappear rapidly with little bed scour. As a result, the river tributaries changed from widths of 40-747 m preflood to 524-1362 m postflood. Sediments deposited were coarse sand and gravel, indicative of the torrential nature of the rainfall and short distance of sediment transport. (Cassar-FRC)
W83-03808

2F. Groundwater

GROUNDWATER RESOURCES OF THE TEXAS RIO GRANDE BASIN,
Texas Univ. at Austin. Dept. of Environmental Health Engineering.
R. J. Charbeneau.
Natural Resources Journal, Vol 22, No 4, p 957-971, October, 1982. 2 Fig, 3 Tab.

Descriptors: *Water supply, *Water requirements, *Water demand, *Groundwater, *Groundwater management, Groundwater mining, Water supply development, Water resources development, Resources development, River basin development, Aquifers, Reservoirs, *Texas, Rio Grande.

The groundwater resources of the Texas Rio Grande Basin are important as a water supply for domestic, municipal, manufacturing, power, mining, livestock, and irrigation purposes. Water supply is adequate to meet needs through the year 2000. The spring flow from the Edwards-Trinity and Carrizo-Wilcox aquifers is regulated by the International Amistad and Falcon Reservoirs. These surface water supplies combined with pumpage for irrigation from the Rio Grande and the Gulf Coast Aquifer meet the neeeds of the lower basin. Groundwater shortage problems exist only in the El Paso-Ciudad Juarez area. Here mined groundwater is being replaced with saline water. The water supply in this area is uncertain in the year 2000. Texas, Mexico, and New Mexico must cooperate to see there is an adequate water supply in the future. (Small-FRC)
W83-03503

COMBINED MOVEMENT OF GROUNDWATERS AND MOISTURE OF THE ZONE OF AERATION,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
V. V. Badov, and A. A. Kiselev.
Water Resources (English Translation), Vol 9, No 1, p 1-10, January-February, 1982. 5 Fig, 31 Ref. Translated from Vodnye Resursy, No 1, p 16-26, January-February, 1982.

Descriptors: *Groundwater movement, *Model studies, Mathematical equations, *Aeration zone, Aeration, Zones, Moisture profiles, *Soil moisture, *Soil water movement.

A model is proposed which reflects the main hydrodynamic characteristics of the combined movement of the groundwaters and moisture of the zone of aeration. A brief review is offered of the main developments and stages in development of concepts about the free surface movement of subsurface waters. This review includes the Boussinesq equation, direct observations made of the formation of the surface of depression of groundwaters, and the complications imposed by infiltration recharge. An attempt was made to create a generalized model of groundwater movement in the form of a system of equations in which the groundwater flow is described by the Boussinesq equation and moisture transport by the Richards equation. Merger of the models of the movement of groundwaters and moisture of the zone of aeration occurred as a result of the development of a fundamentally different approach to the formulation and solution of problems of free-surface flow, that is, problems of flow in a region bounded by an unknown surface of depression but free from the assumption of vertical averaging of the head. The possibilities of an analytic solution of the problem in such a formulation are limited by the conditions of steady flow in the presence of a sufficiently simple configuration of the region of movement. The solution of the plane profile problem of the combined movement of groundwaters and moisture of the zone of aeration gave rise to a new stage in the development of groundwater dynamics in that the components of the process were unified by a general diffusion-moisture model. (Baker-FRC)
W83-03542

AN IMPROVED UNDERSTANDING OF FLOW IN A LIMESTONE AQUIFER USING FIELD EVIDENCE AND MATHEMATICAL MODELS,
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton, E. J. Smith, and L. M. Tomlinson.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 5, p 369-387, September, 1982. 10 Fig, 1 Tab, 13 Ref.

Descriptors: *Aquifer characteristics, *Model studies, *Flow characteristics, Hydraulics, Fluid mechanics, Mathematical studies, Limestone, *England, Southern Lincolnshire Limestone aquifer.

A long-term study of the Southern Lincolnshire Limestone aquifer is described. An understanding of the flow processes within the aquifer was gained from an interplay between field evidence and a mathematical model of the aquifer. A drought occurring in 1976 followed by the very wet winter of 1976-1977 provided valuable information, which means that the mathematical model can be used with confidence to predict aquifer behavior in times of high and low flows. Water balances for the confined region illustrate the interaction between the various inflows and outflows. Particular features which have been important in the 10 year study for this aquifer include: transmissivity and storage coefficient that vary with saturated depth; rapid recharge via swallow holes to the confined region; recharge which is sometimes less than the potential value due to the inability of the aquifer to accept more water; springs which are functions of the groundwater head and are influenced by varying transmissivities; and no net inflow of poor quality connate water from the east. The general approach used in this study is applicable to other aquifers in which the primary mechanism is that recharge occurs in the outcrop region and the water then moves down-dip to the confined region, where major abstraction occurs. However, each aquifer has its own individual features which can only be identified by a detailed field and mathematical model study. (Baker-FRC)
W83-03578

INJECTION AND THERMAL BREAKTHROUGH IN FRACTURED GEOTHERMAL RESERVOIRS,
California Univ., Berkeley. Lawrence Berkeley Lab.
G. S. Bodvarsson, and C. F. Tsang.
Journal of Geophysical Research, Vol 87, No B2, p 1031-1048, February 10, 1982. 30 Fig, 3 Tab, 44 Ref.

Descriptors: *Geothermal studies, *Injection wells, *Groundwater movement, Geologic fractures, Wells, Model studies, Heat flow, Thermal water, Fluid flow.

Cold water injected into a fractured geothermal reservoir will advance along the fractures, gradually extract heat from the adjacent rock matrix, and eventually arrive at the production wells, possibly reducing energy output due to decreasing fluid enthalpies. To predict this possibility, a model was developed for an injection well fully penetrating a fractured geothermal reservoir containing equally spaced horizontal fractures. A constant temperature liquid water is injected into the fractures; the rock matrix is assumed to be impermeable, and the effect of heat conduction on the cold water advancing along the fractures is observed. Type curves were generated for determining the appropriate flow rates and locations of the injection wells in designing injection/production systems. Temperature contour maps were developed to estimate the amount of energy recoverable from the geothermal system, based on a given injection/production scheme. Two simple numerical examples using a hypothetical doublet and the Cerro Prieto geological model are given. Calculations indicate that at typical injection rates in this model the thermal front will have advanced only 240 m away from the injection well after 30 yr of injection. The estimate is independent of fractures in the reservoirs. (Cassar-FRC)
W83-03585

STUDIES IN DYE-TRACING TECHNIQUES AND KARST HYDROGEOLOGY,
Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 5B.
W83-03599

ESTIMATING MIXING IN AQUIFERS BY TEMPERATURE DISTRIBUTION,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
E. S. Simpson, and D. M. McEligot.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235473, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center Completion Report, Tucson, June 1983. 12 p, 2 Fig, 1 Tab, 7 Ref. OWRT A-060-ARIZ(1), 14-31-0001-5003.

Descriptors: Groundwater, *Groundwater dispersion, *Groundwater temperature, Tucson Basin aquifer, *Arizona, *Aquifer, Mixing, *Temperature distribution, Transverse dispersion.

The upper portion of the Tucson Basin aquifer consists of highly transmissive alluvial deposits. Using available measurements of the local geothermal heat flux and a conservative estimate of the coefficient of thermal conductivity of a saturated alluvium, it is found that the calculated temperature gradient due to conduction is nearly twice steeper than the actual temperature gradient measured in wells. Based on the hypothesis that the difference results from convection by random vertical components of average horizontal groundwater velocity, a relationship is developed, using reasoning similar to a development of Reynolds' analogy applied to convective heat transfer in turbulent nonporous flow, that relates random velocities in groundwater flow to convective heat transport. It is further assumed that this convective component for heat transport is related to the transverse (vertical) mixing characteristic of the aquifer for the transport of dissolved species. According to the method developed in this paper, the coefficient of transverse dispersion in the Tucson aquifer is on the order of 400 cm super 2 /day. Assuming a typical seepage velocity of 24 cm/day, the transverse dispersity is 16 cm.
W83-03605

GEOPHYSICAL MAPPING TECHNIQUES FOR GROUNDWATER AVAILABILITY, CENTRAL PIEDMONT PROVINCE, NORTH CAROLINA,
Guilford Coll., Greensboro, NC. Dept. of Geology and Earth Sciences.
For primary bibliographic entry see Field 3B.
W83-03612

SOURCE PROTECTION - AN OUNCE OF PREVENTION,
Dufresne-Henry, Inc., North Springfield, VT. Solid Waste Dept.
For primary bibliographic entry see Field 5G.
W83-03627

MEASUREMENT, PREDICTION, AND HAZARD EVALUATION OF EARTH FISSURING AND SUBSIDENCE DUE TO GROUNDWATER OVERDRAFT,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. N. Davis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243071, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Tucson, Ariz., June 1983. 44 p, 12 Fig, 29 Ref. B-092-ARIZ(1), 14-34-0001-0258.

Descriptors: *Geologic fractures, *Subsidence, Groundwater, Overdraft, Groundwater pollution, Prediction, *Arizona, *Fissures, Hazard evaluation, Gullies.

Earth fissuring associated with subsidence which, in turn, is induced by over-extraction of ground water was studied at several localities in central and southeastern Arizona. Work included detailed mapping of fissures and associated gullies, precise measurements of changes of apertures of fissures, runoff intercepted by fissures, randon emissions associated with areas of fissuring and subsidence, and gravity anomalies related to fissuring. The most basic hydrogeologic controls of fissure development appear to be a combination of differntial compaction of alluvium overlying bedrock irregularities and the desiccation of sediments. The locations of larger fissures which are elongate are determined by bedrock configurations. Fissures having polygonal patterns are probably caused in most places by dessiccation. The desiccation is induced by natural climatic fluctuations as well as by the lowering of ground-water levels. Of the various study techniques used, the most information was obtained from runoff, erosion, and sedimentation measurements. Based on the volume of sediment washed into fissures, total depths of fissures of between 50 and 100 meters appear common. Gullies which feed water into earth fissures develop rapidly in response to only one or two runoff events. These side gullies together with the erosion-enlarged fissures present major hazards to range stock and vehicular traffic on roads and railroads which cross the fissures.
W83-03668

MINERALOGICAL MODEL OF THE FLORIDAN AQUIFER IN THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,
Florida Water Resources Research Center, Gainesville.
A. F. Randazzo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243097, Price codes: A04 in paper copy, A01 in microfiche. Publication No 68, May 1983. 48 p, 14 Fig, 2 Tab, 74 Ref. OWRT B-042-FLA(1), 14-34-0001-0214.

Descriptors: *Groundwater movement, Porosity, Permeability, Groundwater resources, Aquifer management, Limestones, Petrography, Water management, *Aquifers, *Mineralogy, *Diagnesis, *Florida, Geochemistry, Dolomite, Floridan aquifer.

Distribution of geological and hydrochemical parameters in cores and wells penetrating the Floridan aquifer along the west coast of peninsular

Florida is related to the occurrence of dolomite. Trace element analyses of the cores indicate correlations between strontium and sodium concentrations and the particular carbonate phase. Chloride, sulfate, and conductivity values indicate the position and extent of the freshwater-saltwater interface. Thick sequences of carbonate rocks in western peninsula Florida have been dolomitized in the freshwater-saltwater mixing zone. A multivariate computer analyses revealed several trends of environment of deposition parameters. Energy levels and faunal diversities helped to reconstruct the paleoenvironments of these Tertiary carbonate rocks which were coordinated with the stratigraphy of the study area. Correlations between the occurrence of dolomite and specific stratigraphic formations suggest that dolomitization was rock-selective. Evidence of continuous formation of dolomite indicates that the process is actively occurring. The nature and distribution of dolomite has affected porosity. Mineral dissolution and replacement affects groundwater movement. Understanding these interactions will aid hydrologists to inventory more precisely present-day water supplies and to achieve more efficient water management by integrating the mineralogical model with hydrologic data.
W83-03670

A FINITE ELEMENT MODEL TO PREDICT THE FLOW OF UNDERGROUND CONTAMINANTS DUE TO LEAKAGE OF CHEMICAL AND/OR RADIOACTIVE MATERIAL FROM A BURIED CONTAINMENT,
Clemson Univ., SC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W83-03672

WATER BALANCE OF THE PEARL HARBOR-HONOLULU BASIN, HAWAII, 1946-1975,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 4B.
W83-03673

STABLE ISOTOPIC INVESTIGATION OF THE GROUND WATER QUALITY AND TRANSPORT SYSTEMS IN THE SAFFORD VALLEY, ARIZONA,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2K.
W83-03674

WATER CONSERVATION AND GROUNDWATER RECHARGE ON EASTERN LONG ISLAND,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
T. S. Steenhuis, C. Jackson, S. Kung, W. H. Brutsaert, and S. V. Cary.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246520, Price codes: A03 in paper copy, A01 in microfiche. Center for Environmental Research Completion Report, Ithaca, NY, June 1983. 39 p, 9 Fig, 6 Tab, 28 Ref. OWRT B-099-NY(1), 14-34-0001-0236.

Descriptors: *Recharge, *Hydrologic budget, *Evaporation, *Evapotranspiration, *Long Island, *Hydrologic cycle, *Groundwater recharge, *Vadosewater, *Unsaturated flow, Estimating, Heat budget, Heat balance, Meteorology, Soil water, *New York, *Water conservation.

Two methods were tested for their suitability to provide improved estimates of recharge in eastern Long Island: measuring recharge with a direct application of Darcy's Law, and calculating recharge from the hydrologic budget equation with evaporation computed from micrometeorologic data. It was found that the recharge figure, now in general use, of 50% of the annul precipitation is a long-term average at best. Our measurements of recharge performed over a three-year period showed that the vertical flux past the 1 m depth was strongly dependent on both time of year and precipitation amount. In late fall, winter and early spring a high percentage of precipitation became recharge. During the summer months there was a small net upward movement of water past the 1m depth; precipitation did not contribute to the annual recharge. It may be concluded from our measurements that in order to estimate recharge special attention should be given to precipitation during the winter months. A better estimate for annual recharge than the current 50% of annual precipitation might be to take approximately 90%of the precipitation from October 15 until May 15. The two methods used for estimating recharge were labor intensive and required experienced technicians. Currently, one method cannot be recommended above the other. Both methods give a good estimate during the year except for the winter. More research is needed to determine why both methods deviated during the winter.
W83-03703

A STUDY OF RADIUM-226 AND RADON-222 CONCENTRATION IN GROUND WATER NEAR A PHOSPHATE MINING AND MANUFACTURING FACILITY WITH EMPHASIS ON THE HYDROGEOLOGIC CHARACTERISTICS OF THE AREA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W83-03714

GROUND WATER YIELDS AND AVAILABILITY IN FRACTURED CRYSTALLINE ROCKS, WAKE COUNTY, NORTH CAROLINA,
North Carolina State Univ. at Raleigh. Dept. of Marine, Earth and Atmospheric Sciences.
T. M. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-248351, Price codes: A05 in paper copy, A01 in microfiche. M.S. Thesis, 1982. 89 p, 7 Fig, 8 Tab, 32 Ref, 6 Maps. OWRT A-120-NC, 14-34-0001-1135.

Descriptors: *Groundwater, *Geohydrology, *Groundwater availability, *Well yield, Specific capacity, Crystalline rocks, Aquifers, Petrology, Geologic fractures, Topography, Groundwater potential, Groundwater movement, Low flow, Streams, Base flow, Recharge, Well data, Well hydraulics, Pumping tests, *North Carolina, Wake County.

The research investigates the effect of hydrogeologic factors on well yields and the distribution of ground water resources in the fractured crystalline rock aquifers of Wake County, N.C. The characteristics of the fracture system are the most important factors affecting well yield. Lithology is the second most significant variable affecting yield. Topography and saprolite thickness appear to be more significant to well yields than wellsite elevation or distance of well to nearest draw. Mean yields ranged from 45 gpm for wells located in the injected gneiss and schist to 21 gpm for wells located in the injected mica and hornblende gneiss and schist. Unlike most porous, granular aquifers, well yield and specific capacity in fractured crystalline rocks decrease with well depth. A multiple linear regression analysis failed to account for a significant amount of the variation in specific capacity. This failure is believed to be caused primarily by the exclusion of a measure of wellsite fracture characteristics from the model. Several indirect methods were studied to characterize the fracture systems. The Jenkins and Prentice (1982) equation of linear flow appears to be an appropriate method for determining characteristics of a fractured crystalline aquifer. Low flow stream characteristics can also be used to indirectly locate intensely fractured areas and determine relative ground water availability.
W83-03733

CALCULATIONS OF SEEPAGE LOSSES OF WATER BODIES UNDER THE EFFECT OF INFILTRATION INTAKES,
Central Scientific-Research Inst. of Multipurpose Use of Water Resources (USSR).
V. A. Zlotnik, and M. G. Murashko.
Water Resources (English Translation), Vol 9, No 2, p 172-176, March-April, 1982. 1 Fig, 1 Tab, 9 Ref. Translated from Vodnye Resursy, No 2, p 83-88, March-April, 1982.

Descriptors: *Seepage loss, *Aquifers, *Infiltration, Safe yield, Mathematical equations, Mathematical studies, Water storage, Wastewater storage.

Intense and prolonged exploitation of groundwaters leads to the formation of cones of depression having a considerable area. Recharge of water bodies in the presence of a hydraulic connection with aquifers is reduced or replaced by discharge. When estimating the safe yield of infiltration (bank) intakes it is necessary to calculate seepage losses and the drop in the level of surface water bodies, which are determined by the groundwater seepage regime in the zone adjacent to the water body, shape of the water bodies in plan, character of their incision into the exploited bed, degree of siltation of the bottom and banks, and location of the tapping structures. Analogous calculations are necessary when designing infiltration basins and vertical drainage for protecting groundwaters from pollution in the case of spills from industrial wastewater and sludge storage points. Fully penetrating water bodies having a good hydraulic connection with aquifers are a prevalent type. A method is given for calculating seepage losses and drop of the water level in round water bodies when estimating the safe yield of groundwaters for infiltration intakes. (Baker-FRC)
W83-03757

NUMERICAL MODELING OF GROUNDWATER FLOW PROCESSES,
Leningrad Mining Inst. (USSR).
E. A. Lomakin, and V. A. Mironenko.
Water Resources (English Translation), Vol 9, No 2, p 149-157, March-April, 1982. 6 Fig, 30 Ref. Translated from Vodnye Resursy, No 2, p 53-63, March-April, 1982.

Descriptors: *Groundwater movement, *Model studies, Computers, Mathematical models, Groundwater, Flow, Groundwater management, Water supply.

At present, modeling of groundwater flow processes on analog computers is used as an effective method of solving various problems, mainly of a predictive character. A review of current reports indicates an urgent need for developing definite, sufficiently standard criteria which permit an evaluation of various methods and schemes of mathematical modeling of groundwater flow problems. Such criteria based on a theoretical study of the problem and comprehensive analysis of test material should at the same time reflect the specific characteristics of groundwater flow problems. An effective method of mathematical modeling should be viewed in terms of the subjective factors of the simplicity and physical tangibility of the mathematical bases of the method, the availability of technical means of realizing the method, and universality. Also of significance are stability, optimality, possibility of realization and reliability. At present the most promising direction of mathematical modeling of groundwater flow processes should be associated with the wide introduction of numerical methods. One of the most efficient methods for solving linear groundwater flow problems is the alternating direction implicit method in its integro-balance modification. However, for providing conditions of reliability in the practical realization of this method it is necessary to introduce certain constraints on the selection of the time step, which are approximately reflected, for example, by the criterion that the number of time intervals is greater than 5 times K, where K is equal to the pressure capacity times the time step divided by the square of the space step. (Baker-FRC)
W83-03771

2G. Water In Soils

COMBINED MOVEMENT OF GROUNDWATERS AND MOISTURE OF THE ZONE OF AERATION,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2F.
W83-03542

PREDICTING INFILTRATION AND SURFACE RUNOFF FROM RECONSTRUCTED SPOILS AND SOILS,
Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 4C.
W83-03610

TWO-DIMENSIONAL EXPONENTIAL INFILTRATION EQUATIONS,
Y. S. Fok, S. O. Chung, and C. C. K. Liu.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR4, p 231-241, December, 1982. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Infiltration rate, *Wetting, *Irrigation design, Soil water, Irrigation systems, Soil moisture, Equations.

Physical two-dimensional infiltration, important in the design of furrow and drip irrigation systems, was expressed in exponential form by using the vertical and horizontal one-dimensional infiltration equation. It was also assumed that the loci of the wetting patterns for the two-dimensional infiltration are half-ellipses. The equations were evaluated using the soil box method at two soil moisture levels, dry and wetter, using clay loams. For the dry soil moisture level the calculated and observed infiltration rates were in good agreement, within 11%. However, at the wetter soil moisture level the predicted infiltration rates were up to 56% less than observed rates during the first 150 min of infiltration time and up to 14% more during the 150-330 min period. Considering the small arithematic differences between computed and observed accumulative infiltration rates the two values agreed well. Discrepancies were attributed to assumptions made in derivation of the equations, namely, anisotropy and a reduction in vertical hydraulic conductivity with respect to horizontal conductivity. (Cassar-FRC)
W83-03663

DISPOSAL OF HOUSEHOLD WASTEWATER IN SOILS OF HIGH STONE CONTENT,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
For primary bibliographic entry see Field 5D.
W83-03679

MOVEMENT OF BACTERIA THROUGH MACROPORES TO GROUND WATER,
Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 5B.
W83-03705

A REVIEW OF THE USE OF DYES AS SOIL WATER TRACERS,
Soil and Irrigation Research Inst., Pretoria (South Africa). Dept. of Agriculture and Fisheries.
M. J. McLaughlin.
Water SA, Vol 8, No 4, p 196-201, 1982. 5 Fig, 43 Ref.

Descriptors: *Soil water, *Tracers, Environmental tracers, Flow, *Dye release, Dyes, Chemical properties, Chemical interference, Adsorption, Sulfonates, Fluorometry, *Reviews.

The suitability of dyes as soil water tracers is discussed in the light of recent findings. Nonfluorescent dyes are suitable for some applications because they are relatively stable in soil and are inexpensive to use. Fluorescent dyes have the advantage that they are detectable at lower concentrations, but different dyes vary in their susceptability to environmental conditions. No one dye is suitable for all applications. Also, because most of the dyes studied are large molecules, they will be adsorbed to a certain extent by all soils, even if electrostatically uncharged. Although these adsorbed dyes can indicate pathways of flow, they provide little information of the distribution and residence time of water in soil. As yet no dyes have been developed which follow exactly the movement of water in soil. It appears that tracer dyes which perform well as water tracers possess more than one sulfonic acid group, an observation which holds for both fluorescent and non-fluorescent dye types. Compared to other types of tracers such as salts, radioisotopes and biological tracers, tracer dyes appear to offer great potential for simultaneously relating solute distribution in soils to soil physical and morphological characteristics. Parts of the profile active in water movement can be identified without destroying soil structure, thereby enabling valuable soil physical information to be obtained simultaneously with tracer distribution data. (Baker-FRC)
W83-03736

HYDRODYNAMIC DISPERSION INVOLVING CATIONIC ADSORPTION DURING UNSATURATED, TRANSIENT WATER FLOW IN SOIL,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
K. B. Laryea, D. E. Elrick, and M. J. L. Robin.
Soil Science Society of America Journal, Vol 46, No 4, p 667-671, July/August, 1982. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Soil water, Flow, *Solute transport, *Potassium chloride, Chlorides, Salts, Soil properties, Leaching, Infiltration, Permeability, *Transient flow, *Dispersion.

The movement of potassium chloride during the horizontal infiltration of a KCl solution into a semi-infinite soil column of constant initial volumetric moisture content and constant initial salt concentration is described. The soil had been Ca2+ saturated and washed free of salts. The exchange process involved is assumed to be instantaneous and is described by a nonlinear adsorption isotherm. The relevant equations are solved for the apparent longitudinal dispersion coefficient using a computer program written in system/360 CSMP. Experiments performed with a clay loam soil indicate that an apparent longitudinal dispersion function for solutes which interact with the soil matrix may be described by the conventional dispersion equation if it is assumed that because of the usually very low flow velocities in natural soils, the dispersion coefficient is effectively velocity independent. (Baker-FRC)
W83-03749

PERCHED WATER TABLES ON HILLSIDES IN WESTERN OREGON: II. PREFERENTIAL DOWNSLOPE MOVEMENT OF WATER AND ANIONS,
Oregon State Univ., Corvallis. Agricultural Experiment Station.
D. P. Hammermeister, G. F. Kling, and J. A. Vomocil.
Soil Science Society of America Journal, Vol 46, No 4, p 819-826, July/August, 1982. 2 Fig, 4 Tab, 19 Ref.

Descriptors: *Perched water table, *Pores, *Permeability, Macropores, Interstitial water, Soil solution, Anions, Pore velocity, Soil chemistry, Environmental tracers, *Oregon.

Data concerning the movement and halide tracer ions in sloping perched water tables are presented. Halide ion tracers were introduced into line sources at each site of the study during at least two rainstorms in the winter of 1976. Evidence indicates that preferential flow occurred at experimental sites on three hillsides on the border of the Willamette Valley in western Oregon. During saturated flow the very high maximum rates of halide ion movement coupled with both the high concentrations of halide anions when first detected and the rapid movement of anions in directions not predicted from hydraulic gradients and pore velocity vectors suggest that water and solute flow preferentially through large continuous voids. The highly variable pattern of anion movement during saturated flow also points to the preferential nature of water and solute flow. The voids apparently interconnect the A, B, and C horizons and lower depths. The results of experiments conducted in several unsaturated soils during heavy rainfall indicate that preferential flow may occur through continuous macropores, even though the surrounding soil mass is unsaturated. Finally, dye experiments showed a variety of channels and cracks which preferentially conduct dye and water. These continuous macropores ranged in size from about 10 cm down to several tenths of a millimeter. These voids include rodent holes, channels around living roots, crotovinas, cracks between soil peds, and cracks in the underlying lithic and paralithic rocks. (Baker-FRC)
W83-03751

MEASURING THE HYDRAULIC CONDUCTIVITY OF SOIL HORIZONS WITH CONTINUOUS MACROPORES,
Stichting voor Bodemkartering, Wageningen (Netherlands).
J. Bouma.
Soil Science Society of America Journal, Vol 46, No 2, p 438-441, March/April, 1982. 2 Fig, 17 Ref.

Descriptors: *Hydraulic conductivity, *Soil water, Permeability, Infiltration, Unsaturated flow, Saturated flow, *Macropores, Porosity, Soil characteristics, *Netherlands, Soil horizons.

Field data for two soils in the Netherlands were used to study problems arising when interpreting K measurements for saturated soil horizons with continuous macropores. The problems studied were, first, that measured fluxes in a particular soil horizon have different values when the horizon is considered separately or when it is attached to either the underlying or to both the underlying and overlying horizons; and secondly, the fact that fluxes have a wide range of values at saturation, even when measured in one sample within a limited period of time, when infiltration occurs through different light surface crusts. The range of fluxes noted was particularly large for the B21g horizon, which has large vertical worm channels. They conduct much water when they are continous throughout the sample in detached columns. Very light crusts do not induce unsaturated conditions in the subcrust soil. The various examples considered illustrate that flow of water through bi-porous media is difficult to characterize. If feasible, the flow system through the macropores should be separated from the one through the soil matrix. Distinction of a K-sat value for the entire soil, including the macropores, and a K-sat for only the matrix can be helpful for describing the flow system. Of course the concept of K-unsat remains unchanged in terms of a flux at negative pressure heads in the soil matrix. (Baker-FRC)
W83-03754

HEAVY WATER TRACING OF SOIL-WATER TRANSFERS UNDER IRRIGATION,
CEA Centre d'Etudes Nucleaires de Cadarache, Saint-Paul-les-Durance (France). Service de Radio-Agronomie.
P. Moutonnet, and P. Couchat.
Soil Science Society of America Journal, Vol 46, No 2, p 435-438, March/April, 1982. 6 Fig, 6 Ref.

Descriptors: *Irrigation, *Soil water, Permeability, Infiltration, Irrigation programs, Crop yield, Fertilization, Solute transport, Corn.

A laboratory study is reported in which the movement of an added pulse of deuterated water was monitored in a soil column containing maize. Water inputs were automatically controlled by an irrigation device based on soil-water potential measurements made at two different depths in the root zone. The results were analyzed from the standpoint of normal and heavy water balances and of water transfers in soil. Based on the findings of two consecutive experiments, water and heavy water balance and water transfer analysis, the system was found to provide fully satisfactory irrigation. Deuterated water labeling, moreover, proved to be an effective technique for evaluating root uptake in a soil horizon. Molecular diffusion

of deuterium in the soil solution was negligible over the experimental time period, and the gravitational potential results in a downward displacement of the labeled water pulse. (Baker-FRC)
W83-03755

PERCHED WATER TABLES ON HILLSIDES IN WESTERN OREGON: I. SOME FACTORS AFFECTING THEIR DEVELOPMENT AND LONGEVITY,
Oregon State Univ., Corvallis. Agricultural Experiment Station.
D. P. Hammermeister, G. F. Kling, and J. A. Vomocil.
Soil Science Society of America Journal, Vol 46, No 4, p 811-818, July/August, 1982. 4 Fig, 6 Tab, 19 Ref.

Descriptors: *Perched water table, *Permeability coefficient, *Soil water potential, Pressure, Water table, Perched water, Runoff, Oregon, Rainfall-runoff relationships, *Oregon.

Some factors affecting the development and longevity of perched water tables in response to rainfall are examined. Study plots were located on hillsides on the edge of the Willamette Valley in western Oregon. Plots of soil water pressure potentials and rainfall vs time for sites in upper convex slope positions on two hillsides show that impermeable regions of rock are more effective in creating and maintaining zones of saturation. Plots of soil water pressure potentials and rainfall vs time and the calculation of hydraulic gradients for sites located at both upper and lower convex slope positions on these hillslopes suggests that subsurface flow contributes water lower slope positions and is an important factor in determining the longevity of perched water tables. A comparison of the development and maintenance of perched water tables on a lower concave region of slope with upper convex regions of slope shows major differences. Perched water tables last longer in the upper horizons in the lower concave region of slope due to the presence of an impermeable lower B and C horizon and the contribution of subsurface flow from upslope regions of hillside. Perched water tables in the A and B horizons in the lower region developed more rapidly, probably mainly from the infiltration of rainfall to a perched water table already present in the C horizon. However, preferential subsurface flow may also make a contribution to their rapid development. Finally, perched water tables did not form in the upper horizons of a hillside where both the soil and upper rock mantle were highly permeable. (Baker-FRC)
W83-03768

SALT STATUS OF GLACIAL TILL SOILS OF NORTH-CENTRAL MONTANA AS AFFECTED BY THE CROP-FALLOW SYSTEM OF DRYLAND FARMING,
Montana Agricultural Experiment Station, Bozeman.
H. Ferguson, and T. Bateridge.
Soil Science Society of America Journal, Vol 46, No 4, p 807-810, July/August, 1982. 3 Tab, 23 Ref.

Descriptors: *Dry farming, *Groundwater contamination, *Salinity, Leaching, Water quality, Saline seeps, *Montana.

Efforts were made to determine whether measurable quantities of soluble salts have been removed from soils subjected to crop-fallow farming compared to native grassland areas. Findings indicate that crop-fallow farming has caused significant leaching of salts under semiarid conditions. It also indicates that apparently beneficial activities of man can have conflicting long-term consequences. The crop-fallow system stabilized agricultural production in the northern and central Great Plains because of increased water storage in the root zone. It improved the edaphological properties of these young soils through removal of salts by leaching from the root zone. However, the large amount of salts removed from the soil in the recharge areas has resulted in salinization of groundwater and the development of saline seeps. (Baker-FRC)
W83-03769

SOYBEAN RESPONSES TO IRRIGATION AND TILLAGE ON A COMPACTED COASTAL PLAINS SOIL,
Clemson Univ., SC. Dept. of Agronomy and Soils.
For primary bibliographic entry see Field 2I.
W83-03774

TRICKLE IRRIGATION - MODELING WATER AND SOLUTES,
Arizona Univ., Tucson. Dept. of Mathematics.
D. O. Lomen, and A. W. Warrick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249680, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, April 1983. 63 p, 12 Fig, 3 Tab, 59 Ref. OWRT B-097(1), 14-34-0001-1203.

Descriptors: Richards' equation, Unsaturated soil, *Soil water, *Trickle irrigation, *Solute movement, Plant uptake, *Infiltration, Saline water, *Soil-water-plant relationships.

This research addresses the problem of water and salt distribution for geometries appropriate for trickle irrigation. The results of exact solutins of mathematical models for infiltration from point, disc and line sources were put in the form of nomographs. This allows the user to see the relationships between discharge rate, plant uptake and soil water potential at a reference point. The soil characteristics are given by values of K sub o and a in the equation K = K sub o exp (oh), relating the unsaturated hydraulic conductivity to the pressure head. Another analysis using this hydraulic conductivity function described a two-dimensional situation with a rectangular source or sink. The form of this solution allows the user to approximate any explicitly defined root extraction pattern by superimposing several rectangles. A generalized solution was obtained for one-dimensional infiltration using hydraulic functions of Brooks and Corey. Here the results were presented in a 6x20 table which, in principle, allows finding moisture profiles, wetting front, intake rate and cumulative intake for all times, all soils and varying initial water contents. In principle, the method can be used also for multidimensional systems. An analytical solution was developed for one-dimensional salt and water transport in soil systems with a steady intake velocity. Both water and solutes are non-conservative in the sense that they are removed by plant roots. The unique feature of the solution is the coupling of the unsaturated flow to solute uptake by the use of a 'reflection coefficient' describing selective uptake by roots.
W83-03777

CALCULATING THE DEPTHS OF SOIL MOISTURE CONTROL SECTIONS FROM LABORATORY DATA,
Ohio Agricultural Research and Development Center, Wooster.
T. M. Zobeck, and L. A. Daugherty.
Soil Science Society of America Journal, Vol 46, No 4, p 792-895, July/August, 1982. 1 Fig, 4 Tab, 25 Ref.

Descriptors: *Soil water, *Water retention, Mathematical equations, Soil moisture retention, Available water.

Calculations were made of the upper and lower boundaries of a soil moisture control section. These calculations are illustrated using only the depth, bulk density, and saturated, -1/3, and/or -15 bar water contents plus the amount of coarse fragments of the soil horizons. The initial water content of the soil and the final water content after infiltration are extremely important in calculating the depth to which water will penetrate. The amount of water that a soil can retain is equal to the difference between the final and initial moisture contents of a soil throughout the depth of penetration. The results of the analysis suggest that a reasonable estimate of the -60 cm water content can be made knowing only the saturated, -1/3 bar and/or -15 bar water contents. Any one of the water content values can be used alone or in combination with another value for slightly higher reliability to predict -60 cm water contents. Addition of any or all of the other soil characteristics studied to the correlation analysis did not significantly improve the regression. It is recommended that the difference between the -50 to -100 cm and -15 bar water contents be used for determining and defining the soil moisture control section in medium to fine-textured soils. Both moisture contents are reasonable approximations of physically or biologically significant moisture levels and easily determined in the laboratory. The definition would then correspond to the familiar available water-holding capacity (AWC) value currently in use. (Baker-FRC)
W83-03780

FIELD VS. LABORATORY DETERMINED HYDRAULIC CONDUCTIVITIES OF SOME SLOWLY PERMEABLE HORIZONS,
Soil Conservation Service, Gainesville, FL.
F. C. Watts, H. F. Huckle, and R. F. Paetzold.
Soil Science Society of America Journal, Vol 46, No 4, p 782-784, July/August, 1982. 5 Tab, 15 Ref.

Descriptors: *Permeability coefficient, *Soil water, Leaching, Infiltration, Piezometry, Soil types, Field tests, Laboratory studies, Mathematical studies.

A comparison was made between saturated hydraulic conductivity values obtained from the piezometer method and results of the laboratory core method for several soils in the flatwoods region of southeast Florida. The piezometer method was used to measure saturated hydraulic conductivities of spodic and argillic horizons in 15 soils. Textures of argillic horizons in these soils range from sandy loam to sandy clay loam. Spodic horizons in these soils range from sand to loamy sand. There was very poor correlation between hydraulic conductivity values derived from core measurements and those obtained with the piezometer method. This suggests the presence of random variation in addition to the obvious bias. Spodic horizons, based on core data, were placed in moderate and moderately rapid classes except for the Ankona, which was placed in the moderately slow class. Results of the piezometer method indicate that all should be in the very slow class except the Myakka and Pendarvis, which should be classified as moderate and moderately slow, respectively. While a general trend was noted among argillic horizons, the individual data points were widely scattered, and the correlation between hydraulic conductivity and consistence is poor. It was concluded that the core method of measuring saturated hydraulic conductivity consistently gave larger values than the piezometer method. The magnitude of the difference in results obtained using the two methods varied from two to over 700-fold. The core method gave hydraulic conductivity values that are too large when used in the design of water control systems. (Baker-FRC)
W83-03781

CONSTANT-FLUX INFILTRATION FROM A HEMISPHERICAL CAVITY,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
B. E. Clotheir, and D. R. Scotter.
Soil Science Society of America Journal, Vol 46, No 4, p 696-700, July/August, 1982. 6 Fig, 18 Ref.

Descriptors: *Infiltration, *Soil water, *Mathematical studies, *Fluctuations, Soil moisture availability, Irrigation programs, Trickle irrigation, Water supply, Diffusion.

The process of constant-flux infiltration from a cavity using a method based on the flux-concentration appoach of Philip and Knight is reinvestigated. Other existing theories of three-dimensional infiltration are also studied. The results show that infiltration at 360 ml/hr into a 4 mm radius hemispherical cavity in a repacked fine sand was described quite well by the simple absorption theory for the first 100 min. However, after this time period at this flux, the effects of gravity became evident, as would be expected based on a comparison of the matric and gravitational potential gradients. The nonlinear, steady-stage infiltration theory

of Raats gave reasonable estimates of the water content profiles behind the wet front. The linearized theory of Warrick was of no value in this context. The success of the Raats theory adds some credence to the use in trickle irrigation design of Woodling's theory, which describes infiltration from a circular pond on the basis of the same assumptions. (Baker-FRC)
W83-03782

SOIL PARAMETERS AND SAMPLING SCHEME FOR CHARACTERIZING SOIL HYDRAULIC PROPERTIES OF A WATERSHED,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
E. Bresler, and R. E. Green.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-253294, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No. 148, December 1982. 42 p, 15 Fig, 5 Tab, 28 Ref. A-094-HI(1), 14-34-0001-2113.

Descriptors: *Hydraulic conductivity, Hydrologic models, *Sampling statistics, Surface-groundwater relationships, Soil water, Watershed(Basins), Monte Carlo method, *Hawaii, *Soil hydraulic indices, *Geostatistics, Saturated conductivity, Drainage-flux method, Kriging, Autocorrelation, Variogram, Spatial variability, Oxisols, Pearl Harbor watershed, Oahu.

Watershed modeling, which incorporates the stochastic nature of the hydraulic properties of the land surface and rainfall, requires a mathematical description of watershed variability, including the frequency distribution of key hydrologic parameters and the spatial structure of variances. Heterogeneous watersheds require extensive sampling to characterize the spatial distribution of a property, such as hydraulic conductivity, which is frequently required as input to model calculations of infiltration and runoff. Since hydraulic conductivity, K, varies with water content, theta, and soil water pressure, h, the K(theta) and K(h) relationships can be conveniently represented by parameters in mathematical expressions relating these variables. The parameters of three different equations are examined as indices of the hydraulic properties of Oxisols soils in Hawaii's Pearl Harbor watershed. When what to measure and how to mathematically express the results is decided, the number and location of field measurement sites in a particular watershed are determined. Geostatistical concepts are applied to design a sampling scheme for a specific watershed in which the measured value of a hydrologic property or index at a given point is correlated with other measured values of the property that is dependent on the distance between sampling points. Required statistical parameters for the geostatistical approach are the mean, variance, and autocorrelation function or variogram. Criteria are specified for selecting the location and smallest possible number of observation points to best estimate the statistical parameters. The results suggest that 30 measurement sites are the minimum sample size for estimating the parameters required for stochastic modeling. The proposed sampling procedure is illustrated with a sampling strategy for a portion of the Pearl Harbor watershed.
W83-03817

2H. Lakes

ENVIRONMENTAL LIMITING FACTORS AFFECTING THE GROWTH AND SPREAD OF CHALCALBURNUS TARICHI (PALL. 1881) (PISCES: CYPRINIDAE) IN BURDUR LAKE (DIE UMWELTFAKTOREN, DIE DIE VERBREITUNG UND ENTWICKLUNG VON CHALCALBURNUS TARICHI (PALL. 1881) (PISCES: CYPRINIDAE) IN BURDUR-SEE BEGRENZEN),
Istanbul Univ. (Turkey). Fen Fakultesi.
For primary bibliographic entry see Field 5C.
W83-03543

SILICA IN LAKES: NUTRIENT COMPETITION, EQUILIBRIUM REACTIONS IN SEDIMENT PORE WATERS, AND ROLE IN METAL CYCLING,
Wisconsin Univ.-Madison. Dept. of Water Chemistry.
D. E. Armstrong, M. A. Anderson, M. L. Machesky, N. Peterson-Holm, and M. Shafer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246488, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center Technical Report WIS WRC 83-05, 1983. 48 p, 14 Fig, 12 Tab, 71 Ref. OWRT B-101-WIS(2), 14-34-0001-8128.

Descriptors: *Diatoms, Lakes, *Metals, *Nutrients, *Silica, Algae, Asterionella, Microcystis, Sediments, *Wisconsin, Cyanophta, Dissolved solids, Phosphorus, Aluminum, Iron, Water pollution effects, Pollutant identification, *Growth kinetics, *Algal growth.

The nutrient uptake and growth kinetics of a freshwater diatom (Asterionella formosa) and the bluegreen alga (Microcystis aeruginosa) under P or Si limitation were determined in batch culture at 20C. Asterionella had a higher maximum growth rate and a lower half saturation constant for growth than Microcystis under P limitation. The maximum uptake velocity for P was higher for Asterionella than for Microcystis while the half-saturation constants for P uptake were similar for the two species. Concentrations of dissolved silicon, iron and aluminum were measured in the hypolimnetic and sediment pore waters of several Wisconsin lakes representing a range from high to low silicon concentration. Corresponding measurements of pH and temperature were also made. Equilibrium expressions were developed for various Al-Si, Fe-Si, and Fe-Al-Si phases. Required thermodynamic data for the various dissolved species and crystalline and amorphous solids were obtained, and corrections were made for activity and temperature. Predicted concentrations of dissolved species for various solid phases were compared with observed concentrations to evaluate the solid phases apparently controlling dissolved Si, Al, and Fe. Particulate silicon composition and trace metal interactions were investigated in Lake Michigan. During early suummer, diatom silicon represents a high proportion of the suspended particulate matter. The investigation of diatom-metal interactions is continuing.
W83-03699

DIATOMS OF LAKE OF THE OZARKS, MISSOURI,
Missouri Univ.-Columbia. Div. of Biological Sciences.
M. A. Pamperl.
O(7), OWRT-14-34-0001-9027, 0127.

Descriptors: *Diatoms, Periphyton, Phytoplankton, Indicator organisms, Reservoir flora, Sampling, *Missouri, Lake of the Ozarks.

During the summers 1977 and 1978 the diatom communities of Lake of the Ozarks, Missouri were studied. Samples were collected at two-week intervals from six stations located in different regions of the reservoir. Four types of samples were collected at all stations - plankton tows, splash zone and 0.5 m rock scrapings, and scrapings from glass slides placed just below the water's surface. Buoy scrapings were collected at four stations. One hundred fifty-seven diatom taxa were identified from Lake of the Ozarks during the study. Of these taxa, 46 were found to be dominant in at least one of the nearly 300 samples examined. Taxa considered typical of clean water were abundant at stations near Bagnell Dam. Diatoms typical of water rich in nutrients were common at stations farthest from the dam. About one-third of the diatom taxa of Lake of the Ozarks have been reported from other reservoirs in Missouri and bordering states.
W83-03723

SIGNIFICANCE OF FLOODPLAIN SEDIMENTS IN NUTRIENT EXCHANGE BETWEEN A STREAM AND ITS FLOODPLAIN,
East Carolina Univ., Greenville, NC. Dept. of Biology.
M. M. Brinson, D. Bradshaw, and R. N. Holmes.
In: Dynamics of Lotic Ecosystem (Chapter 10), Ann Arbor Science Publishers, Ann Arbor, Mich., 1983. p 199-221, 7 Fig, 1 Tab, 29 Ref. OWRT B-114-NC(3), 14-34-0001-8107.

Descriptors: Streams, *Flood plains, *Swamps, *Sediments, *Cycling nutrients, Lotic environment, Rivers, Overflow, Flood flow, *Nitrogen, *Phosphorus, Nitrate, Ammonium, Phosphate, Sediment-water interfaces, Interstital water, Nitrification, Denitrification, Nitrogen removal, Phosphorus removal, Seasonal variation, Radioactive tracers, *North Carolina, Tar River.

This study describes some of the mechanisms by which nitrogen and phosphorus levels are altered in the surface water of a floodplain swamp and examines how this may ultimately affect concentration of these nutrients in the stream channel during hydrolobic events that drain floodplain water into the stream. A year-long comparison of stream channel and floodplain water of the lower Tar River, North Carolina, established that hydrologic phases resulting in water flow from floodplain to stream channel would dilute nitrate (and usually ammonium) concentrations in stream water. In contrast, floodplain drainage water would normally augment filterable reactive phosphorus in the stream. Seasonal experiments were conducted on sediment-water exchanges of nitrate, ammonium, and phosphate in the floodplain to examine some of the mechanisms responsible for alterations in nutrient concentrations of surface water. Nitrate loss exceeded ammonium loss from surface water to which these ions were added above background levels. Loss rates of both ions were greater in July and November than in February, the coldest month. Nitrogen-15 tracer experiments confirmed a one-way pathway of nitrate from the surface water; this was made possible by denitrification in the sediments. Ammonium diffusion was bidirectional between surface water and sediments. Background concentrations of inorganic nitrogen in interstitial water of surface sediments underwent greatest changes during warm season dry down. Loss of super 32PO4 from surface water was mostly by abiotic mechanisms during all seasons and was entirely so during the coldest part of the year.
W83-03724

HYDROCHEMICAL METHODS OF INVESTIGATING PRODUCTION AND DESTRUCTION PROCESSES IN NATURAL WATERS,
All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
V. V. Sapozhnikov.
Water Resources (English Translation), Vol 9, No 2, p 204-208, March-April, 1982. 5 Fig, 1 Tab, 5 Ref. Translated from Vodnye Resursy, No 2, p 122-128, March-April, 1982.

Descriptors: *Primary productivity, *Measuring instruments, Natural waters, Lakes, Productivity, Aquatic productivity, Dissolved oxygen, Oxygen, Photosynthesis, Acidity, *USSR, Mozhaisk reservoir.

The physiochemical effects of photosynthesis on the pH value and dissolved oxygen are examined for the example of the Mozhaisk reservoir, where a device for automatic recording of dissolved oxygen, pH, water temperature, and underwater illumination has been in operation for six years. In fresh waters, owing to the low buffer action of the water, the changes in pH as a result of photosynthesis are exhibited most clearly. The efficiency of vertical mixing during transport of oxygen downward into colder layers of the reservoir increases as a result of greater solubility of oxygen in waters with a lower temperature. In the Mozhaisk reservoir supersaturation of more than 100% was sometimes noted at depths to 7.0 m. Under conditions of marked stratification of waters on calm days, obviously, such a mechanism of reaeration of waters of the hypolimnion is the dominant one. The effect of inertial oscillations is hardly perceived in the hypolimnion under the thermocline. Automated methods of measuring production and destruction processes have gained special significance recently, when in biohydrochemistry there was a change to

an analysis of processes rather than recording of the end results of their occurrence. A strong temporal variability of production and destruction processes which depends on the variability of external physiochemical conditions was demonstrated. It is concluded that hydrochemical methods are the most effective means of studying production and destruction processes. It was estimated that a string of thermooximeters permits estimating primary production beneath 1 sq m in the entire water column, and continuous recording of oxygen makes it possible to observe the redistribution of dissolved oxygen due to processes of vertical eddy diffusion. Automatic measurements of pH and dissolved oxygen give considerably more correct ideas about the productivity of a water body in situ than bottle determinations of primary production performed by the oxygen or radiocarbon techniques. (Baker-FRC)
W83-03756

VERTICAL DISTRIBUTION OF ZOOPLANKTON IN THE MOLOGA RIVER IN WINTER,
I. K. Riv'yer, S. S. Bakastov, and A. I. Saralov.
Hydrobiological Journal, Vol 17, No 3, p 11-16, 1981. 6 Fig, 8 Ref.

Descriptors: *Vertical distribution, *Zooplankton, Temperature effects, Dissolved oxygen, Oxygen, Water temperature, Rivers, Mologa River, Rybinsk Reservoir, *USSR, Water level, Flow rate, Bacteria, Methane bacteria, Cold regions, Cyclopoida, Rotifers, Reservoirs.

Vertical distribution of zooplankton in a flooded, slow-moving river was studied in February-April 1978 at a station on the Mologa Rive where the river channel is 200 m wide and 14.4-16.5 m deep. During this period the reservoir was being emptied, and by late March the snowmelt water began to arrive. The variations in zooplankton population depended on temperature (0 to 2 C), water level, rate of flow, dissolved oxygen concentration (0 to 10 mg per liter) and distribution of bacteria (1 to 3 million cells per ml). The dominant groups of zooplankton were rotifers and cyclopoids. (Cassar-FRC)
W83-03815

FACTORS CONTROLLING PHYTOPLANKTON IN LAKE VANDA (77 DEGREES S),
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
W. F. Vincent, and C. L. Vincent.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 12, p 1602-1609, December, 1982. 2 Fig, 7 Tab, 26 Ref.

Descriptors: *Phytoplankton, *Photosynthesis, *Nutrients, Lake Vanda, *Antarctica, Lakes, Oligotrophic lakes, Phosphorus, Cold regions, Algae, Iced lakes, Cyanophyta, Flagellates.

Three distinct algal communities were identified in different sections of the water column of permanently ice-covered Lake Vanda, Antarctica, considered the world's clearest and most oligotrophic lake. At the 3.25 m depth Ochromonas miniscula, Polytomella sp. and Chlorella sp. were found. At 30 m the common organisms were Chlorella sp, Chlamydomonas globosa, Phormidium fragile, and P. antarcticum. At 55 m P. antarcticum, P. frigidum, Synechocystis, and P. fragile were present. Microflagellates were predominant in the upper two strata and blue-green algae in the lowest strata. Maximum photosynthesis was at the bottom of the euphotic zone, 55-57.5 m, just above a region of nutrient-rich anoxic water. Two less-pronounced maxima were recorded higher in the water column, one just under the ice and the other at 15-35 m in the center of a large thermohaline convection cell. Phosphorus was very limited, and plankton showed strong P deficiency. Between mid-December and mid-January chlorophyll a levels and cell biomass declined markedly, suggesting that the populations reach maxima early in the season when light is weaker and the Antarctic region is inaccessible to researchers. Temperatures in the bottom layer of the lake reached 18-20 C, characteristic of temperate lakes. (Cassar-FRC)
W83-03838

2I. Water In Plants

THE EFFECT OF EXCESS AND LIMITED SOIL MOISTURE ON NITROGEN FIXATION OF SEVERAL LEGUMINOUS CROPS,
Florida Water Resources Research Center, Gainesville.
J. M. Bennett, and S. L. Albrecht.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246421, Price codes: A04 in paper copy, A01 in microfiche. Publication No 69, May 1983. 62 p, 28 Fig, 4 Tab, 36 Ref. OWRT A-044-FLA(1), 14-34-0001-1110, 14-34-0001-2110.

Descriptors: Aeschynomene americana, Alfalfa, Bean, Cowpea, Desmodium heterocarpon, *Drought, *Flooding, Leaf water potentials, Soybean, Water relations, *Water stress, Stomatal conductance, *Soil moisture, *Plant growth.

Greenhouse experiments were conducted to examine the effects of flooding and drought on the leaf and nodule water status, stomatal conductance, root respiration and nitrogen fixation of cowpea (Vigna unuiculata L.), alfalfa (Medicago sativa L.), soybean (Glycine max L.), bean (Phaseolus vulgaris L.), Aeschynomene americana, and Desmodium heterocarpon. Soybeans, cowpeas, and Aeschynomene exhibited a tolerance to flooding and the capacity to fix nitrogen in flooded plants remained about the same as the well-watered controls, whereas flooded Desmodium, bean, and alfalfa showed marked reduction in nitrogenase activity with a concommitant decline in plant water status and root respiration. Drought stress resulted in reductions in leaf and nodule water potentials, stomatal conductance, and root respiration as gravimetric soil water content decreased below 1% in the sandy soil medium. In general, nitrogenase activity declined along with other physiological processes, however, there was an indication that nitrogen fixation was more severely inhibited by drought. Rewatering previously drought stressed plants completely restored control levels of the measured physiological parameters.
W83-03687

SOYBEAN RESPONSES TO IRRIGATION AND TILLAGE ON A COMPACTED COASTAL PLAINS SOIL,
Clemson Univ., SC. Dept. of Agronomy and Soils.
V. L. Quisenberry, and H. L. Musen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-248385, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Publication No 111, Clemson Univ., S. C., August 1983. 33 p, 15 Fig, 2 Tab, 19 Ref. OWRT B-110-SC(1), 14-34-001-7186.

Descriptors: Irrigation, Tillage, Water management, Water transport, Soil water, Soil-water-plant relationships, Soil water potential, Soil compaction, *Soybeans, Evapotranspiration, Crop response, Crop yield, *South Carolina.

Two soybean cultivars (Bragg and Ransom, Maturity Groups VII and VIII, respectively) were grown for three years on a Norfolk sand (Typic Paleudult) at Blackville, S. C. Tillage treatments (disked and in-row subsoiling) and irrigation treatments (0.2 bar and no irrigation) were the main plots of a randomized complete block with cultivars the split-plot treatment. For the 3-year average, in-row subsoiling resulted in significantly higher yields than did disking alone. Yields under irrigation were significantly greater than without irrigation. Whereas, subsoiling increased yields under no irrigation, there was no significant difference due to tillage treatments under irrigation. The Norfolk soil usually contains a very compacted zone in the Ap and/or A2 horizon which reduces root development, thereby reducing available water. The data show that by maintaining the soil water pressure greater than 0.2 bar in the upper 60 cm of the profile with irrigation, in-row subsoiling is not necessary. In situ hydraulic conductivity and soil water characteristic curves were measured within the experimental area. From these data, evapotranspiration rates were calculated for each treatment from tensiometer values of soil water pressure. The data show that for maximum yields to be obtained, the ET rate must be equal to or greater than 0.9 open pan evaporation during the reproductive stage of soybean growth.
W83-03774

2J. Erosion and Sedimentation

SOURCES AND FATES OF SEDIMENTARY ORGANIC MATTER IN THE WHITE OAK AND NEUSE RIVER ESTUARIES,
North Carolina Univ. at Chapel Hill. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W83-03590

DISCUSSION: FLOW RESISTANCE IN COARSE GRAVEL BED RIVERS,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 8B.
W83-03644

SIMULATION OF NUTRIENT, MICROORGANISM, AND HEAVY METAL TRANSPORT CAPACITY OF SUSPENDED SEDIMENT,
Arizona Univ., Tucson. School of Renewable Natural Resources.
P. F. Folliott, and W. O. Rasmussen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-248344, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Tucson, Ariz., August 1983. 23 p, 3 Fig, 4 Ref, 1 Append. OWRT A-105-ARIZ(4), 14-34-0001-1103.

Descriptors: *Erosion, *Sediments, Nutrients, Heavy metals, *Simulation model, Southwestern U.S., Microorganisms, *Computer programs, Prediction, Water quality control.

SEDCON, a computerized prediction technique (using vegetative and geologic data), which was developed to estimate land management impacts on the physical and chemical characteristics of transported suspended sediment in watersheds of the southwestern United States, is described. A hypothetical example is given to show that, after inputting experimental data or using the default values, estimated values of nutrient (acid digestible and extractable chemicals) and heavy transport capacities of suspended sediment and for (winter or summer) combinations of mixed conifer or ponderosa pine forests and basaltic, granitic, and sedimentary geologies can be displayed.
W83-03732

PARAMETERS FOR DESCRIBING SOIL DETACHMENT DUE TO SINGLE WATERDROP IMPACT,
Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
M. M. Al-Durrah, and J. M. Bradford.
Soil Science Society of America Journal, Vol 46, No 4, p 836-840, July/August, 1982. 2 Fig, 4 Tab, 28 Ref.

Descriptors: *Erosion, *Soil properties, Soil strength, Soil physical properties, Rainfall, Soil erosion, Erosion control.

A simple relationship between soil detachment and single raindrop impact was examined on eight materials having a wide range of particle sizes. For all soils and drop sizes, the weight of soil splash decreased as bulk density increased and matric potential decreased. However, the differences in soil splash weights between three bulk density levels became smaller as the matric potential decreased. A curvilinear relationship was noted between soil splash weight and near-surface shear strength and a relationship dependent on raindrop size. When examining a specific soil, the selection of shear strength as a soil parameter for estimating soil splash was proper. However, the shear strength term does not fully account for differ-

ences in splash weights among soils. Correlating splash weights to the soil properties of sand content, silt content, clay content, texture, organic matter, surface area, pH, soluble salts, CEC, and exchangeable cations plus soil bulk density, matric potential and raindrop energy, without considering the surface shear strength, proved to be unsatisfactory in this study. A maximum coefficient of determination of 0.61 was found from using many combinations of the independent variables in a multiple regression model. This indicates the lack of a direct relationship between the measured soil physical and chemical properties and the actual forces that determine soil detachability. Although the tested splash model using the soil surface shear strength did not full account for differences among soils, it is suggested that the study results show that the concept of a force-resistant type model can be use to predict splash weights. (Baker-FRC)
W83-03750

SURFACE SOIL PHYSICAL PROPERTIES AFTER 36 YEARS OF CROPPING TO WINTER WHEAT,
Texas Agricultural Experiment Station, College Station.
P. W. Unger.
Soil Science Society of America Journal, Vol 46, No 4, p 796-801, July/August 1982. 4 Tab, 19 Ref.

Descriptors: *Soil properties, *Surface drainage, *Erosion, Soil water, Crop yield, *Wheat, Fallow, Tillage, Organic matter, Aggregates, Erosion control.

The effects of long-term practices on dry and water-stable aggregate distribution, OM (organic matter) concentration, modulus of rupture, penetrometer resistance, particle-size distribution, and bulk density of clods of the surface soil were investigated. The field study was conducted on Pullman clay loam. Oneway, sweep, and delayed sweep tillage were used on continuous wheat fallow plots, and oneway and sweep tillage were used on continuous wheat plots. Whether plots of the wheat-fallow system had been cropped to wheat or fallowed during the last wheat season before terminating the study usually had no significant effect on measured soil properties. Although significant differences in soil physical properties or conditions were found due to 36 years of different tillage methods and cropping systems for winter wheat, the differences were relatively small, and no tillage method or cropping system resulted in a condition that seemingly would adversely affect wheat production. In some cases the differences were significantly related to soil organic matter concentration, which after 36 years was higher for sweep than for oneway disk tillage and higher for the continuous wheat than for the wheat-fallow system. No tillage method or cropping system resulted in sufficient large, stable dry aggregrates to effectively control wind erosion, thus pointing to a need to maintain surface residues to aid in controlling erosion. The higher yields with sweep than with oneway tillage and for wheat-fallow than for continuous wheat were apparently related to greater water conservation rather than to any soil physical condition. (Baker-FRC)
W83-03805

ROUTING GRADED SEDIMENTS IN STREAMS: APPLICATIONS,
Tippetts-Abbett-McCarthy-Stratton, New York.
D. K. Borah, C. V. Alonso, and S. N. Prasad.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY12, p 1504-1517, December, 1982. 8 Fig, 2 Tab, 18 Ref.

Descriptors: *Sediment transport, Streams, Model studies, River beds, *Sediment grading, Alluvial channels, Armoring, *Colorado, San Luis Valley Canal, *Wyoming, East Fork River.

A one-dimensional numerical model for movement of well-graded sediments through streams was tested with data from two laboratory flumes and two alluvial channel reaches, the San Luis Valley Canal, Colorado, and the East Fork River, Wyoming. The sediment model required the adjustment of only one parameter, the erodibility parameter. The model predicted water and sediment discharges coming out of each reach, size distribution of these transported materials, size distribution of the bed material or the armor coat, and changes in bed elevation. Model predictions agreed reasonably well with the observed data available. (Cassar-FRC)
W83-03832

ROUTING GRADED SEDIMENTS IN STREAMS: FORMULATIONS,
Tippetts-Abbett-McCarthy-Stratton, New York.
D. K. Borah, C. V. Alonso, and S. N. Prasad.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY12, p 1486-1503, December, 1982. 4 Fig, 16 Ref.

Descriptors: *Sediment transport, Streams, River beds, Armoring, Model studies, *Sediment grading, Alluvial channels.

The movement of well-graded sediments through a stream network was simulated with a one-dimensional numerical model based on the physical processes governing the mechanics of sediment transport in alluvial channels. This model is suitable for noncohesive materials, relatively stable channel geometrics, streams with negligible out-of-bank transport, and flows without transverse currents. It recognizes the effect of sediment gradation on the stream's transport capacity. It accounts for the effect of particle exchange between sediment load and bed layer and simulates bed armoring, changes in bed elevation, and longitudinal sorting of eroded material. (Cassar-FRC)
W83-03833

2K. Chemical Processes

HYDROGEOCHEMICAL INVESTIGATIONS WITH REGARD TO THE ORIGIN OF HEAVY METALS IN GROUNDWATER (HYDROGEOCHEMISCHE UNTERSUCHUNGEN ZUR HERKUNFT VON SCHWERMETALLEN IM GRUNDWASSER),
Technische Univ., Munich (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
P. Udluft, and K-E. Quentin.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 15, No 1, p 6-11, 1982. 3 Fig, 11 Tab, 10 Ref. English abstract.

Descriptors: *Heavy metals, *Weathering, *Rocks, *Precipitation, *Groundwater, Erosion, Aquifers, Lead, Copper, Zinc, Cadmium, Chromium, Cobalt, Nickel, Mercury, Alps, *Federal Republic of Germany, Chemical analysis, Geochemistry, Geohydology, Chemical composition.

The output of heavy metals from an aquifer belonging to the zone of oxidation is mainly controlled by the weathering of rocks. A simple mass balance between the amounts of precipitation and the input into the soils by weathering shows the significance of precipitation. The concentration of heavy metals in groundwater can be explained completely by transport of solutions originating in chemical weathering. Due to the very low migration factor of iron, only this element shows a dominant enrichment in the soils caused by weathering. This highest ratio between the input of precipitation and the output of groundwater is given by Pb (80:1), followed by Cu, Zn, and Cd (10:1). The other elements (Cr, Co, Ni, Hg) are placed between 5:1 and 1:1. In the Alps, however, the input of precipitation shows the range of the groundwater output of Cu, Zn, Cd, and Pb. (Author's abstract)
W83-03511

CARBONIC ACID-CALCIUM CARBONATE EQUILIBRIUM IN SURFACE GROUNDWATERS OF NORTHEASTERN BAVARIA/F. R. G. 1. SIMPLE METHODS FOR CALCULATING 'ACIDIC AGGRESSIVENESS' AND CARBONATE DISSOLUTION TENDENCY (KALK-KOHLENSAURE-GLEICGEWICHT IN OBERFLACHENNAHEN GRUNDWASSERN NORDOSTBAYERNS I. EINFACHE GLEICHGEWICHTSBERECHNUNGEN ZUR 'SAUREAGGFRESSIVITAT' UND KALKLOSUNGSTENDENZ),
Bayreuth Univ. (Germany, F.R.). Lehrsuhl fuer Hydrologie.
T. Frevert, E. Schrimpff, and I. Baumgartner.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 15, No 2, p 58-69, 1982. 1 Fig, 2 Tab, 16 Ref. English abstract.

Descriptors: *Groundwater, *Calcium carbonate, *Acidic water, *Acidity, *Mathematical studies, Chemical properties, Chemical analysis, Water analysis, Bavaria, *Federal Republic of Germany.

Some variables pertinent for carbonic acid/calcium carbonate equilibria were determined in 15 calcareous and non-calcareous surface groundwaters of northeastern Bavaria. The measured data were compared with the corresponding thermodynamic data in order to find the degrees of non-equilibrium in the groundwaters. The use of a simple pocket computer was found to be feasible for this purpose. With respect of P(CO2) (atmosphere/groundwater) and to the dissolution tendency of calcium carbonate, non-equilibria prevailed (the so-called Langelier index i has always been negative). It seemed to be useful to introduce a parameter analoguous to the Langelier index which characterizes 'acidic aggressiveness' irrespective of the presence of undissociated calcium carbonate. Only the non-calcareous or extremely non-calcareous groundwater showed a negative 'acidic aggressiveness' parameter, corresponding to the Langelier indices of less than -2. This may be due to their high virtual dissolution intensity vs. calcium carbonates. (Author's abstract)
W83-03512

CARBONIC ACID-CALCIUM CARBONATE EQUILIBRIUM IN SURFACE GROUNDWATERS OF NORTHEASTERN BAVARIA. II. SPATIAL AND TEMPORAL VARIANCES (KALK -KOHLENSAURE GLEICHGEWICHT IN OBERFLACHENNAHEN GRUNDWASSERN NORDOSTBAYERNS. II. ZUR HYDROCHEMISCHEN RAUMLICHEN UND ZEITLICHEN VARIANZ),
Bayreuth Univ. (Germany, F.R.). Lehrsuhl fuer Hydrologie.
E. Schrimpff, T. Frevert, and I. Baumgartner.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 15, No 4, p 187-191, August, 1982. 1 Fig, 3 Tab, 5 Ref. English abstract.

Descriptors: *Carbonic acid, *Groundwater, Acidity, Alkalinity, Calcium carbonate, Seasonal variations, Spatial distribution, Multivariate statistical methods, Statistical methods, Mathematical studies, *Federal Republic of Germany, Bavaria.

Samples were taken of 15 northeastern Bavarian surface groundwaters and studied for conductivity, pH, chloride content, titration-alkalinity, titration-acidity, hardness and dissolved carbon dioxide. Multivariate statistical methods were used in the evaluation of the data collected. According to the results of principal component analysis only the variables of pH, specific conductivity, alkalinity and hardness were closely correlated. All the other variables showed poorer interrelationships. Spatial clustering of the mean values of 7 non-weighted and independent variables led to 6 groups of 2 groundwaters, 1 group of 3 groundwaters and 2 single groundwaters. However, clustering all data revealed the predominance of time vs spatial variance by groups of winter-spring or spring-summer data. Combining the hydrochemical and statistical results the following conditions were characteristic for all wells: in winter - 'acidic aggressiveness' - low water yield and low buffering intensity; in spring - 'acidic non-aggressiveness' - high water yield and high buffering intensity. (Baker-FRC)
W83-03514

ACID RAIN: SOURCES AND EFFECTS IN CONNECTICUT REPORT OF THE ACID RAIN TASK FORCE,

Connecticut Agricultural Experiment Station, New Haven.
T. Bertinuson, and C. A. Frink.
Bulletin 809, January 1983. 14 p, 4 Fig, 3 Tab, 39 Ref, 2 Append.

Descriptors: *Acid rain, *Air-water interfaces, *Water-air interfaces, *Acidic water, *Rainfall, *Chemical properties, Acidity, Air pollution effects, Air pollution, Human diseases, Air-earth interfaces, Earth-air interfaces, *Connecticut.

The Acid Rain Task Force examined the nature and sources of acid rain and its effects on soil and water, fish, vegetation, structures, and human health. The study concluded that the sources of acid rain and other air pollutants in Connecticut are not readily quantified, due in part to the varied components of acid rain. Rain in Connecticut has an average pH of about 4.3 to 4.4, which is highly acidic compared to unpolluted rain which has a pH of 5.6. The more distant the source, the more difficult it becomes to specify that source. However, it is clear that regions and perhaps even states can be identified as source areas. The effects of acid rain on the environment of Connecticut are seen as subtle. The soils are generally well-buffered and show no evidence of acidification by acid rain. Measurements of the alkalinity of 35 lakes show little or no change since measurements taken in 1937-1939, but there are 1000 lakes in the state large enough to have names, and some changes may have gone undetected. There is no evidence that fish in the lakes have been affected by acid rain, nor is there evidence of damage to agricultural crops or forests. However, current levels of air pollution may cause genetic, biological and/or ecosystem changes that have yet to be identified. Structures are affected by acid rain as can be seen in the weathering of some statues and building stone. There is little evidence of any direct effect of acid rain on human health, although there is no question that some forms of air pollution are hazardous to health, such as fine particulate aerosols. (Garrison-Omniplan)
W83-03561

TEACHER'S RESOURCE GUIDE ON ACIDIC PRECIPITATION WITH LABORATORY ACTIVITIES,
Maine Univ. at Orono. Coll. of Education.
L. H. Barrow.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-227405, Price codes: A02 in paper copy, A01 in microfiche. Land and Water Resources Center Completion Report, Univ. of Maine, Orono, June 1983. 19 p. OWRT A-057-ME(3), 14-34-0001-2121.

Descriptors: *Acid Rain, Air pollution, Coal, *Education, Fallout, Oxides, Rainfall, Pollutant identification.

The purpose of this teacher's resource guide is to help science teachers incorporate the topic of acidic precipitation into their curricula. A survey of recent junior high school science textbooks found a maximum of one paragraph devoted to the subject; none of these textbooks had any related laboratory activities. It was on the basis of this near void that this manual was developed. The guide includes introductory material designed to give an overview of causes and effects of acidic precipitation, its relation to energy production, and some possible ways of reducing or eliminating it. In addition, six laboratory activities (independent of one another) are included. These investigations are appropriate for students utilizing concrete operational thought patterns. Some are modifications of activities published by the Acid Precipitation Awareness Project. The guide also refereces several additional resources for teachers and students who wish to pursue the topic futher.
W83-03565

STABLE ISOTOPIC INVESTIGATION OF THE GROUND WATER QUALITY AND TRANSPORT SYSTEMS IN THE SAFFORD VALLEY, ARIZONA,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
A. Long.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243139, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, July 1983. 75 p, 21 Fig, 2 Tab, 31 Ref. OWRT A-107-ARIZ(1), 14-34-0001-1103.

Descriptors: Groundwater quality, Groundwater movement, Stable isotopes, Safford Valley, *Arizona, *Isotope studies, Geochemistry, Thermal water, Ion chemistry, Water-mineral equilibria.

Integration of geologic, hydrologic, major-ion chemical, stable-isotope and radioisotope data from Safford indicates that the Safford thermal waters are produced by deep circulation into the basin, which has relatively normal thermal characteristics. These waters are forced to the surface by pressure derived from the high-standing mountain ranges at the basin margins. The absence of shifts in isotopic composition off the meteoric line idicates that the temperatures in the reservoirs are too low to permitboiling (shift to the left) or water-mineral isotope-exchange reactions (shifts to the right of the meteoric line). In the absence of shifts, the isotopic compositions of the thermal waters indicate the isotopic compositions in their source area(s) and imply that the surrounding mountain ranges were the source area. The water-mineral equilibria relationships of waters sampled along hypothesized flow paths also indicate a mountain source for thermal waters and define the flow paths of waters recharged at the mountain fronts to deep aquifers in the basin sediments. Similar studies can be applied to geothermal systems throughout the Basin and Range, providing that variations in the stable-isotope and major-ion chemistry of waters are discernable in the basin of interest.
W83-03674

SOLUBILIZATION RATE OF ATMOSPHERIC PARTICULATE MATTER AND IMPACT ON WATER QUALITY,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 5B.
W83-03677

EFFECTS OF ACID DEPOSITION (RAIN) ON A PIEDMONT AQUATIC ECOSYSTEM: ACID INPUTS, NEUTRALIZATION, AND PH CHANGES,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 5C.
W83-03700

CHEMISTRY OF THE SPRINGS OF THE OZARK MOUNTAINS, NORTHWESTERN ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Geology.
K. F. Steele.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246561, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 98, Univ. of Arkansas, Fayetteville, May 1983. 50 p, 3 Fig, 13 Tab, 26 Ref. OWRT A-055-ARK(1), 14-34-0001-1104.

Descriptors: *Chemical analysis, *Heavy metals, Groundwater, *Springs, *Arkansas, *Mineralization, Lead, *Zinc, Geochemistry.

Three lead-zinc mineralized areas of northern Arkansas were selected to study the effect of mineralization on ground water chemistry. The Ponca area has the largest amount of lead sulfide mineralization, the Zinc area has a significant amount of zinc silicate and zinc sulfide; whereas, the Rush area has zinc carbonate and zinc sulfide. A total of 143 samples were collected from these areas and analyzed for general water chemistry parameters including heavy metals. The water quality of the area is generally good, however, a few springs exceed the drinking water standards for ammonia, nitrate, iron, manganese and lead. The surface temperatures and subsurface temperatures (determined from silica geothermometry) do not indicate any significant geothermal heating of these spring waters. Geochemical exploration using ground water chemistry, especially lead, appears to be very useful in outlining these lead-zinc mineralized areas; however, location of individual deposits using ground water chemistry does not appear to be promising.
W83-03707

CHEMICAL COMPOSITION OF RAIN WATER OVER LUCKNOW IN 1980,
Central Groundwater Board, Lucknow (India).
B. K. Handa, A. Kumar, and D. K. Goel.
Mausam, Vol 33, No 4, p 485-488, 1982. 4 Tab, 3 Ref.

Descriptors: *Chemical composition, *Rain, *Trace elements, Lucknow, *India, Water analysis, Precipitation, Fate of pollutants, Metals, Acidity, *Pollutant identification.

Rainwater collected over Lucknow, India, from June to December 1980 was analyzed. This area, several hundred km from the sea, is affected by industrial and domestic air pollution, gases from anaerobic decomposition in agricultural lands and swampy areas, emanations from surface water bodies, and other airborne pollutants from adjacent areas. There was no evidence of acid rain; pH values found ranged from 6.55 to 8.15. Chemical composition of the rain varied with each shower, but it was predominantly of the bicarbonate type. Mean values for constituents were: electrical conductivity, 24.9 miscrosiemen per cm; bicarbonates.83 mg per liter; chlorides, 1.14 mg per liter; nitrates, 2.12 mg per liter; Ca, 1.70 mg per liter; Mg, 0.43 mg per liter; Na, 0.59 mg per liter; K, 0.32 mg per liter; and silica, 0.24 mg per liter. Mean trace element levels (micrograms per liter) were: Fe, 26.5; Zn, 9.74; Sr, 3.63; Cu, 3.08; Mn, 2.45; Mo, 1/10; and Ag, Co, Cd, Cs, Li, and Rb, all <1.0. The highest Cd value in a sample was 2.5 micrograms per liter. (Cassar-FRC)
W83-03809

2L. Estuaries

BIOGEOCHEMISTRY OF THE SEDIMENTS OF THE PAMLICO AND NEUSE RIVER ESTUARIES, NORTH CAROLINA,
East Carolina Univ., Greenville, NC. Dept. of Biology.
E. A. Matson, M. M. Brinson, D. D. Cahoon, and G. J. Davis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-236133, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 191, North Carolina State Univ., Raleigh, May 1983. 115 p, 26 Fig, 23 Tab, 150 Ref. OWRT B-143-NC(1), 14-34-0001-1256.

Descriptors: *Estuaries, *Geochemistry, *Sediments, *Nutrients, Rivers mud, Sand, Sediment-water interfaces, Interstitial water, Cycling nutrients, Carbon, Nitrogen, Phosphorus, Phytoplankton, Bacteria, *North Carolina, Neuse River, Pamlico River.

This is a survey of the composition, distribution, and sources of surface sediments in the Pamlico and Neuse River Estuaries. The interstitial(pore) waters of the sediments were also studied to estimate the decomposition stoichiometry of organic matter and the diffusive flux of NH, FRP(filterable reactive phosphorus), SO, Si, DIC(dissolved inorganic carbon), and Cl. The sediments of the two estuaries were quite similar. Mud deposits ($>90\%$ silt + clay) covered 90% of the area of both, and the remainder was sandy sediments near shore or upriver of the transition zone. There was a progressive decrease in total organic carbon(TOC) and total phosphorus(TP) concentrations downriver, but the total Kjeldahl nitrogen(TKN) did not change. Data indicate that deposition of estuarine phytoplankton carbon governs the organic chemistry of the top meter of sediments in the lower two thirds of the estuaries, while in lower-salinity upriver areas, freshwater carbon is evident. Total annual diffusional flux of NH and FRP from the sediments represents 7.7 and 5.4% of average

annual phytoplankton N and P uptake in surface waters. Bioturbation and advection of pore waters, as well as large pulsed nutrient fluxes from anoxic bottom waters, could increase these estimates almost 5 fold. Only about half of the calculated N and P of phytoplankton sedimentation is returned to the water column, thus storage and recycling of nutrients within the sediments is occurring.
W83-03620

TROPHIC ENERGETICS IN ARCTIC FRESHWATER ECOSYSTEMS,
Alaska Univ., Fairbanks. Inst. of Water Resources.
D. M. Schell, and P. Ziemann.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-236141, Price codes: A02 in paper copy, A01 in microfiche. Completion Report 80-11, October 1981. 17 p, 5 Fig, 12 Ref. OWRT A-069-ALAS(1), 14-34-0001-1102.

Descriptors: *Aquatic productivity, *Primary productivity, Food chain, Food pyramids, *Food webs, Limnology, Ecology, Fishes, Rivers, Ecology, *Detritus, Aquatic life, *Alaska, Colville River, *Organic carbon, Harrison Bay.

The inputs of organic carbon from the Colville River and from shoreline erosion to Harrison Bay dominate the energy input to this system. This large input of allochthonous carbon is utilized by microorganisms and the secondary production is transferred up the food web to comprise a large fraction of the carbon in amphipods sampled from Harrison Bay during November, based on the carbon-14 content of the amphipods. The anadromous fishes entering marine waters attain an isotopic composition typical of marine fishes by late summer. Upon entering the freshwater system, however, the food web dependencies shift drastically and by spring, the anadromous fishes sampled (least cisco, broad whitefish) were almost completely derived from peat as indicated by a large depression in C-14 content. These data indicate two critical facts regarding anadromous fish populations: 1. Overwintering anadromous fishes in the Colville River feed actively and turn over their entire body carbon. They do not overwinter on fat reserves acquired during summer marine feeding. 2. Overwintering fishes are heavily dependent upon peat as an energy source, probably via insect larvae as principal consumers. By June, least cisco and broad whitefish are 69-65% peat carbon.
W83-03621

DEVELOPMENT OF REGIONAL WETLAND RESTORATION GOALS: COASTAL WETLANDS,
California Coastal Commission, San Francisco.
For primary bibliographic entry see Field 6G.
W83-03691

ENGINEERING WETLANDS: CIRCULATION, SEDIMENTATION, AND WATER QUALITY,
California Univ., Davis. Dept. of Civil Engineering.
R. B. Krone.
In: Wetland Restoration and Enhancement in California, M. Josselyn, ed. California Sea Grant College Program Report No T-CSGCP-007, Tiburon Center for Environmental Studies, San Francisco State Univ., December 1982. p 53-61, 4 Fig.

Descriptors: *Wetlands, *Dikes, *Marshes, *Sedimentation, *Water quality, *Soil engineering, Estuaries, Hydraulic design, Tidal flats, Tides, Soil stability, Suspended solids, Sedimentation rates, Flood control storage, Algal control, Catchment areas.

Marshes result from the combined effects of tides, rising sea level, sediment transport, and marsh plants. Restoring diked lands to viable marshes includes restoration of flooding and draining regimens by gravity flows, and importation of fresh sediments that provide conditions for growth of desired plant species. Marsh plants promote deposition of sediment among themselves by facilitating aggregation of suspended particles and by protecting deposited material from wave action. Hydraulic design consists of application of unsteady flow computations to the peculiar conditions of marshlands, with tides, friction, and conveyance dimensions, either specified or adjustable. One-dimensional hydraulic representations are suitable; two-dimensional models are too detailed. Methods for constructing dikes and channels on marshlands is difficult because excavating equipment gets mired in the saturated soil. Data on suspended sediment concentrations, needed to compute sedimentation rates, are rarely available so they must be estimated using rates from other sites. However, rates of sedimentation in shallow ponds typically slow as the water gets shallower. Water quality in restored marshes requires minimizing conditions favorable for mosquito larvae, such as by providing drainage for depressions in the marsh surface, and preventing the development of algae scum by providing short retention time in ponds and channel ends that do not drain completely. Lands to be restored to marsh might have other uses, such as recreation, education and/or flood water storage. These factors must be considered in designing the physical facilities. (Atkins-Omniplan)
W83-03693

RESTORATION TECHNIQUES, RESEARCH, AND MONITORING: VEGETATION,
San Diego State Univ., CA.
J. Zedler, M. Josselyn, and C. Onuf.
In: Wetlands Restoration and Enhancement in California, M. Josselyn, ed. California Sea Grant College Program Report No T-CSGCP-007, Tiburon Center for Environmental Studies, San Francisco State Univ., December 1982. p 63-74, 9 Tab.

Descriptors: *Wetlands, *Marshes, *Coastal waters, *Regional development, *Vegetation, Ecosystems, Wildlife habitats, Submerged plants, Algal control, Grasses, Saline soils, Salt marshes.

Marsh vegetation provides a transition from aquatic to terrestrial habitats. This paper summarizes the ecological features of wetland vegetation, reviews data on California's wetland vegetation, outlines ecological factors in planning marsh establishment, and suggests research programs to improve restoration efforts. The emphasis is on emergent and submerged vegetation, particularly salt marshes. California's wetlands have extremely variable hydrologic regimes, some stressful and some beneficial to plant productivity. Soil salinity is also a major factor in marsh composition and productivity. The three main restoration goals--restoring what has been degraded, turning dredge spoil deposits into wildlife habitat, and treating sewage effluent--require appropriate communities. The techniques used to do that include modifying water circulation, establishing new substrate elevations, and planting. Some values that argue for incorporating eelgrass beds in coastal wetland restoration are that primary production is very high, it may filter sewage, coastal stabilization could occur, the density and biomass of animals is much higher, and the environment enhances fish production. Restoration techniques are still experimental; therefore, once the restoration goals and site conditions, including elevations and soil characteristics, have been established, specific implementation plans can begin. The site should be monitored before and after implementation. These efforts must be sufficient to determine what caused a success or failure and the results should be made readily available to be useful to future projects. (Atkins-Omniplan)
W83-03694

ANALYSIS OF COASTAL MARSH ECOSYSTEMS: EFFECTS OF TIDES ON VEGETATIONAL CHANGE,
Connecticut Univ., Storrs. Inst. of Water Resources.
W. C. Kennard, M. W. Lefor, and D. L. Civco.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246926, Price codes: A08 in paper copy, A01 in microfiche. Completion Report, June 1983. 151 p, 30 Tab, 47 Fig, 25 Ref, 3 Append. OWRT B-014-CONN(1), 14-34-0001-0212.

Descriptors: *Aerial photography, *Coastal marshes, *Computer applications, *On-site data collection, *Plant populations, *Remote sensing, *Satellite technology, *Spartina, Spatial distribution, *Tidal marshes, *Tide effects, Temporal distribution, Vertical distribution, Aquatic ecosystems, Ecology, Elevation, Species density, Species diversity, Topographic mapping, *Connecticut.

Three study sites along the Connecticut coast were used for detailed analysis of tidal regime, salt marsh vegetation distribution, and microelevation. Surveyed belt transects extending from water's edge to upland transition, measuring 10 x 70 m, and onsite tide gauges were established and data gathered over three seasons. Elevation and plant species distribution data were subjected to discriminant analysis. It was determined that the landward extent of Spartina alterniflora Loisel. (tall form) indicates the line of mean high water on a salt marsh. Photointerpretation, mapping, and cover analysis of successive imagery from five overflights from 1934 to 1981 showed a net increase in coverage by S. alterniflora, perhaps indicating a response to an increase in sea level, among other factors. Digitized vegetation maps were used to detect changes in plant species distribution. An image processing system, PICPAC, was developed for thematic mapping of coastal ecosystems cover types from digital satellite imagery. The report contains extensive narrative enhanced by 30 tables and 47 figures, including 18 manually-prepared and nine computer-generated cover classification maps.
W83-03708

MINERALOGY OF SEDIMENTS IN THREE ESTUARIES ON OAHU, HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
P. C. Ekern, and P-F. Fan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-248310, Price codes: A03 in paper copy, A01 in microfiche. Technical Memorandum Report No 68, June 1983. 33 p, 7 Fig, 8 Tab, 34 Ref. OWRT A-043-HI(6), 14-31-0001-4011, -5011, 14-34-0001-7025, -7026.

Descriptors: *Mineralogy, *Sediments, *Estuaries, Alluvial deposits, Geomorphology, X-ray diffraction, Watersheds, *Oxisol, *Mollisol, *Inceptisol, Vertisol, Kaneohe Bay, Maunalua Bay, Pearl Harbor, *Hawaii.

Semiquantitative X-ray diffraction was used to determine the relative abundance of minerals in sediments from three estuaries on Oahu, Hawaii. The watersheds of the three sites represent diverse environments: Kaneohe Bay, a windward northeast facing lagoon-bay complex; Maunalua Bay, a leeward south facing, heavily urbanized area; Pearl Harbor, a blend of urban-agricultural estuarine complex on the leeward central portion of Oahu. Five suites of mineralogic assemblages were found: basaltic, secondary clay, hydrothermal-aeolian, marine carbonate, and authigenic. Carbonates prevailed in the sediments in Kaneohe Bay except near stream mouths. Primary minerals of the basaltic suite dominated the terriginous sediments from the streams, buy iron-rich secondary minerals were common and quartz and mica of aeolian origin and some hydrothermal christobalite were present. Secondary clay minerals and hematite were the main constituents of the suspended sediments carried to Maunalua Bay. In Pearl Harbor the basaltic suite was dominant near the stream mouths. Secondary clays and aeolian quartz and illite were found where salinity and currents allowed deposition. Authigenic pyrite was formed where anaerobic conditions developed in organic depositions. Montmorillonitic minerals correpond to the source soils derived from tuff. Heavy metals in Kaneohe Bay resembled the soil and rock levels but considerably higher levels were found accumulated in the fine sediments in Pearl Harbor.
W83-03728

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES V. KROMME AND GAMTOOS RIVER (ST. FRANCIS BAY),
Port Elizabeth Univ. (South Africa). Dept. of Zoology.

For primary bibliographic entry see Field 5B.
W83-03738

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES VI. SUNDAYS RIVER,
Port Elizabeth Univ. (South Africa).
For primary bibliographic entry see Field 5B.
W83-03739

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

RO VS. MSF FOR HIGH-CAPACITY SEAWATER DESALINATION PLANTS,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
C. T. Sackinger.
Power Engineering, Vol 86, No 8, p 56-58, August, 1982. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Reverse osmosis, *Desalination, *Multistage flash distillation, Distillation, Seawater, Membrane processes, Flash distillation, Costs, Capital costs, Energy.

Reverse osmosis offers several advantages over multistage flash (MSF) distillation for seawater desalination. Energy costs for reverse osmosis are significantly less than for thermal processes. For a 5.56 mgd dual-purpose reverse osmosis plant producing 71.4 MW of electric power, energy requirements are 6.61 kWh per cu m of water produced. Fuel consumption is 19.38 tons per hour for reverse osmosis and 21.5 tons per hour for MSF. Annual fuel savings are 18,536 tons or $3.7 million cost savings at a price of $30.60 per barrel. Capital costs for a Key West, Florida, 3 mgd reverse osmosis plant put on line in December 1980 were $3 per gallon processed per day. (Cassar-FRC)
W83-03622

NOVEL COMPOSITE MEMBRANES,
Bend Research, Inc., OR.
E. K. L. Lee, H. K. Lonsdale, W. C. Babcock, R. P. Barss, and M. E. Tuttle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243170, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, April 1983. 40 p, 20 Fig, 8 Tab, 16 Ref. OWRT C-10004-S(No 1449)(1).

Descriptors: *Membranes, *Desalination, *Reverse osmosis, *Chlorine, Saline water, Seawater, Brackish water, *Composite membranes, Chlorine resistance, Mechanisms of chlorine attack, Membrane processes.

A serious limitation of most high-performance composite reverse-osmosis (RO) membranes is their sensitivity to chlorine attack. The objective of this program was to develop membranes with good desalination performance and improved chlorine resistance. A composite polyamide membrane designated 3N8(OL) was developed which exhibited no significant degradation with over 50 days of cumulative exposure to 0.5 ppm chlorine (as NaOCl) at pH 6.5. This degree of chlorine resistance was comparable to that of the best commercial membrane (FT-30 produced by FilmTec Corporation). The best 3N8(OL) membranes exhibited an NaCl rejection of 99.32% and a water flux of 34 gal/ft super 2-day (gfd) under the test conditions of 800 psi and 1-wt% NaCl feed; with a 3.5-wt% NaCl feed the rejection obtained was 97.9% at a water flux of 12 gfd. Thus, this membrane is suited for brackish-water treatment but not for single-pass seawater desalting. Even better chlorine resistance was exhibited by a second membrane, designated 2N31. At the end of a 500-hour accelerated chlorine-resistance test at 10 ppm NaOCl and pH 6.5, no salt rejection decrease was detectable. At 800 psi and with a 1-wt% NaCl feed, the average salt rejection observed was 97.7% and the water flux was 7.4 gfd. Thus, this membrane is superior in chlorine resistance to 3N8(OL) or FT-30 but has only modest RO performance. The probable mechanisms of chlorine attack in polyamide membranes and the likely identity of the reacting species have been summarized.
W83-03678

3B. Water Yield Improvement

GEOPHYSICAL MAPPING TECHNIQUES FOR GROUNDWATER AVAILABILITY, CENTRAL PIEDMONT PROVINCE, NORTH CAROLINA,
Guilford Coll., Greensboro, NC. Dept. of Geology and Earth Sciences.
C. C. Almy, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235770, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute, Completion Report, North Carolina State Univ. at Raleigh, May 1983. 20 p, 56 Ref. OWRT A-118-NC(1), 14-34-0001-1135.

Descriptors: Geophysics, *Groundwater availability, Gravity studies, Magnetic studies, Seismology, *Water supply development, Groundwater mining, *Groundwater potential, Bedrock, Alluvium, Geologic fractures, *North Carolina, *Mapping.

Limited surface water supplies in populous Guilford County, North Carolina, necessitate wise use and management of groundwater resources. In the search for suitable groundwater supplies, this study explores the usefulness of gravimetric, magnetic, and refraction seismic techniques in differentiating among types of bedrock, soil/saprolite, and floodplain alluvium as well as the detection and delineation of hydrologically important fracture zones. Gravity and magnetic surveys have proved useful in delineating major bedrock units. Seismic refraction work indicates alluvial fill over the bedrock directly or over saprolitic material in the valley. Preliminary studies of fracture patterns and the development of predictable fracture occurences aid in groundwater recovery. The ability to map the unconsolidated cover, as well as the underlying bedrock, permits closer control on groundwater migration and occurences and provides the possibility of using the regolith as a primary water source, as well as the fractured bedrock, the traditional source of groundwater in this area. The successful applications of these geophysical techniques can reduce the risk and cost of locating high-yield wells.
W83-03612

SOME CURRENT PROBLEMS IN INVESTIGATIONS OF THE INTERACTION OF SUBSURFACE AND SURFACE WATERS OF THE USSR,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 6D.
W83-03734

WATER HARVESTING FOR AFFORESTATION: III. DEPENDENCE OF TREE GROWTH ON AMOUNT AND DISTRIBUTION OF PRECIPITATION,
Research Inst. of Forests and Rangelands, Tehran (Iran).
A. Kowsar.
Soil Science Society of America Journal, Vol 46, No 4, p 802-807, July-August, 1982. 1 Fig, 2 Tab, 17 Ref.

Descriptors: *Water harvesting, *Water supply development, *Surface runoff, Asphalt, Paving, Water resources development, *Iran, Irrigation practices, Trees, Vegetation establishment, *Tree growth, Precipitation.

Information was sought concerning the continued survival and growth rate of the rain-fed, nonirrigated trees in the afforestation projects in Iran. Verification was also sought of the runoff efficiency predictive equation is presented in earlier studies, and predictive equations were developed which could be used in planning aforestation projects with and without employing procedures for water harvesting. In order to harvest the needed water for sustaining tree growth, asphalt was sprayed onto the sloping soil surface, and runoff from the sealed area was conserved in soil of level basins constructed below them. Drought-enduring, cold-resistant trees were planted in these basins. The complete deterioration of the asphalt membrane 5 years after installation along with growth of vegetation on these treated and untreated control plots has reduced efficiency of both to almost nil. Survival of the tree species 9 years after planting on asphalt-treated and control plots was not significantly different statistically. Although the runoff contribution of the asphalt-sprayed microwatersheds was negligible during the 1975-78 period, the additional water received by the treated trees in previous years resulted in extra growth of height, crown area, and stem cross section. The tree species varied considerably in response to the additional water, apparently due to the differences in the phenology and physiology of a leguminous tree, a nonleguminous tree and a coniferous tree. Trees on asphalt-plots generally grew taller than controls. It was concluded that water harvesting by soil surface application of asphalt is a low cost substitute for the wasteful irrigation practices presently used for establishing greenbelts in Iran. (Baker-FRC)
W83-03752

STREAM-WATER STORAGE IN THE OCEAN USING AN IMPERMEABLE MEMBRANE,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
E. T. Murabyashi, M. Asuka, R. Yamada, Y. S. Fok, and H. K. Gee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-248369, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 152, May 1983. 67 p, 15 Fig, 2 Tab, 30 Ref. 4 Append. OWRT B-065-HI(1), 14-34-0001-9262, 2113.

Descriptors: *Water storage, Moveable dams, *Reservoir linings, *Reservoir storage, *Membranes, Hydraulic, models, Irrigation water, *Stream-water storage, West Loch, Pearl Harbor, Oahu, *Hawaii.

The conceptual feasibility of storing fresh water in the ocean was investigated using a plastic membrane as the reservoir liner. In the initial phase, two physical hydraulic models were constructed to test the concept. The first was a water-filled, glass-sided box to observe the movement and reaction of the membrane to various simulated effects of currents, waves, and sediment deposition. The second was a 1:400-scale model (6.7 x 6.1 m) of West Loch, Pearl Harbor (a potential field application site), with 1:24 vertical exaggeration for similitude. The curtain method was used because it can enclose a large water body. The effect of wind, waves, tides, and currents on the curtain were simulated and the reactions observed. Although modeling is a useful tool for investigating initial concepts, its direct field application is limited because of scaling. Actual field testing on an initial pilot-stage basis constituted the second phase. Curtains, floating reservoirs, and bags were constructed of polyethylene sheets and deployed. All worked well after modifications were made following initial testing. The bag is the easiest to deploy because it is prefabricated and ready for use. No field attachment of floats and anchors is necessary as for curtains or floating reservoirs; however, the latter two have certain characteristic advantages which may override this difficulty. Based on this experimental experience, the concept of membrane water-shortage appears feasible and further development work leading to operational equipment seems justified. Selection of suitable membrane material is one of the key factors to be explored, along with effects of weathering and biota. Quiescent waters are essential to the success of this concept.
W83-03772

DEEP WELLS DON'T RUN DRY,
J. Gordon.

New Zealand Jornal of Agriculture, Vol 145, No 6, p 8-9, December, 1982.

Descriptors: *Wells, *Aquifers, *Irrigation water, Canterbury, *New Zealand, Groundwater irrigation.

Irrigation wells sunk within the past 5 years near Canterbury, New Zealand, began to run dry during the drought of last summer and autumn because they had been drilled too shallow during a period of high water table. The North Canterbury Catchment Board is involved in groundwater use and planning to help farmers sinking new wells to choose a proper location and depth for reliable water supplies. Some older wells in the region, believed to be going dry, upon investigation were found to be clogged by failure of screening systems and corrosion. For this area groundwater irrigation is most sensible. Supplies are nearly inexhaustible because several large gravel bed aquifers, remnants of ancient rivers, run through the area. (Cassar-FRC)
W83-03810

3C. Use Of Water Of Impaired Quality

INNOVATIVE TECHNOLOGY RECYCLES WASTE.
Hirsch and Co., San Diego, CA.
For primary bibliographic entry see Field 5D.
W83-03545

A SURVEY OF SOILS IRRIGATED WITH ARKANSAS RIVER WATER,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
J. T. Gilmour, H. D. Scott, and R. E. Baser.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235234, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 96, Univ. of Arkansas, Fayetteville, March 1983. 46 p, 4 Tab, 19 Ref, 1 Append. OWRT A-062-ARK(1), 14-34-0001-2104.

Descriptors: Irrigation, Conductivity, Hydrogen ion concentration, Saline water, *Saline soils, Salinity, *Soil physical properties, Sodium, *Sodium chloride, Water quality, *Arkansas River, Arkansas, *Irrigated soils.

Interest in the use of Arkansas River water for irrigation has increased recently as land adjacent to the river is converted to crop production and river water is considered as an alternative to depleted underground supplies. Since the Arkansas River can contain elevated concentrations of sodium chloride, this study was designed to determine if soil conditions adverse to crop growth were developing where river water has been used. The impact of river water on sites where river water was used as either the sole source for up to three years or a supplement to another surface source for up to twenty years was evaluated. The mean surface and profile ESPs were both 3.7%, while parallel ECs for a 1:2 soil:water extract were 183 and 163 umhos/cm, respectively. Mean surface and profile chloride concentrations were 32 and 50 ug/g, respectively. Mean saturated hydraulic conductivities were 0.0115 cm/hr for the surface soil. No data were obtained which suggested that the use of the Arkansas River under the conditions described above was detrimental to soil physical or chemical properties. Periodic re-evaluation of this conclusion is suggested at site where direct use of Arkansas River water continues for an extended period of time.
W83-03589

GROWTH, DEVELOPMENT, AND ROOT QUALITY OF SWEET POTATO AS INFLUENCED BY SOIL WARMING,
North Carolina State Univ. at Raleigh. Dept. of Horticultural Science.
D. C. Sanders, W. C. Porter, R. W. Skaggs, and D. M. Scheirer.
HortScience, Vol 16, No 4, Aug 1981. p 537-539, 1 Fig, 3 Tab, 6 Ref. OWRT A-060-NC(6), 14-31-0001-4033.

Descriptors: *Thermal water, *Heated water, *Plant growth, *Soil temperature, Subsurface irrigation, Sweet potatoes, Waste heat, Sprinkler irrigation, Crop production.

Power plants are a major source of waste heated water which because of the known effects of thermal pollution cannot be returned as is to native water resources. Previous studies have indicated a beneficial use of heated water; namely soil warming, which enhances growth of various plants. In the present work fresh and dry weights of the above ground plant of 'Copper Skin Jewel' and 'Jewel' sweet potatoes (Ipomoea batatas (L) Lam.) increased with soil warming but total yield of roots was unaffected. Soil warming increased root size, root epidemal color intensity, and improved internal color but decreased percent dry weight, and root pH. Evaporative cooling reduced the foliage weight, storage root fresh weight and total weight of 'Jewel' but not of 'Copper Skin Jewel.' Subirrigation did not influence any of the parameters mentioned above.
W83-03615

AN EVALUATION OF SEASHORE MALLOW, KOSTELETZKYA VIRGINICA (L.) PRESL., AS A POTENTIAL NEW CROP WHICH CAN BE GROWN IN BRACKISH WATER,
Delaware Univ., Newark. School of Life and Health Sciences.
F. G. Somers, and D. M. Grant.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-236109, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center Completion Report, Univ. of Delaware, Newark, June 1983. 32 p, 20 Tab. OWRT A-048-DEL(2).

Descriptors: *Brackish water, *Seashore mallow, Irrigation water, *Marsh plants, Agriculture, Crop production, Alternative water use, Nutrients, Salt water use, *Salt tolerant plants, Saline water.

Seashore mallow, Kosteletzkya virginica (L.) Presl., a plant native to brackish areas of coastal marshes of southeastern United States, was grown in field plots irrigated with water from a tidal stream and in the laboratory in a nutrient solution (Hoagland's) salinized with sea salts. In the field the seed yield did not respond to application of N-P-K fertilizer, in contrast to previous observations. The plants grew well when irrigated 0, 3, or 5 times weekly with tidal-stream water. The highest yields were with 0 and 5X and with a 22.5 cm spacing between plants. In growth-chamber experiments, growth was reduced by salinity, particularly 10 o/oo. Markedly greater growth was obtained when the nutrient solution was changed weekly and the nutrient solution was aerated, but in the presence of an excess of a slow-release fertilizer aeration resulted in reduced growth and lowered the pH. Salinization of the nutrient solution increased diffusive resistance, decreased the water lost by transpiration, and reduced the chlorophyll content of the leaves. The amount of water lost per gram increase in dry matter was decreased by salinization. Despite a very substantial transpirational water loss, most of the Na super + remained in the nutrient solution at the end of the experiments.
W83-03618

THE NITROGEN BALANCE OF VEGETABLE CROPS IRRIGATED WITH UNTREATED EFFLUENT,
Chile Univ., Santiago. Dept. of Inorganic and Analytical Chemistry.
For primary bibliographic entry see Field 5B.
W83-03745

3D. Conservation In Domestic and Municipal Use

DISCUSSION: RESIDENTIAL WATER CONSERVATION,
Blatchley Associates, Inc., Denver, CO.
R. K. Blatchley.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR2, p 240-242, June, 1982. 2 Ref.

Descriptors: *Water conservation, *Peak demand, *Domestic water, Municipal water, Water use, Pricing, Water demand, Irrigation, Lawns.

The paper, 'Residential Water Conservation' by J. E. Flack, published in the Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers in March, 1981, is described in this discussion as academic and idealistic. Estimates, not hard data, were used. The paper failed to mention that reducing peak flow demands may require significant capital costs. Recycling treated wastewater for public use, as suggested, is not allowed by law in some states. The critic felt that some of the figures on lawn size and daily household demand were exaggerated. A 100% irrigation efficiency in lawn watering is not attainable. Water use restrictions by scheduling reduce peak demand but may not reduce overall consumption. (Cassar-FRC)
W83-03658

WATER CONSERVATION IN RESIDENTIAL DEVELOPMENT: LAND-USE TECHNIQUES,
American Planning Association, Chicago, IL.
W. Sanders, and C. Thurow.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249573, Price codes: A03 in paper copy, A01 in microfiche. Planning Advisory Service Report No 373. American Planning Association, Chicago, December 1982. 34 p, 26 Fig, 1 Tab, 46 Ref, 3 Append. OWRT C-00018-T (No 0425)(1).

Descriptors: *Water conservation, *Urban planning, *Zoning, *Land use, *Local governments, Conservation, Legal aspects, Governments, Urbanization, Landscaping.

This report, written for land-use planners in local government, describes how local governments around the country are reducing residential water demands. In particular, it examines water conservation provisions in comprehensive city plans on zoning and subdivision regulations designed to conserve water. It discusses how such land development considerations as housing types, lot layout, landscaping requirements, and density provisions can be used to reduce water consumption in new residential development. The report also provides an overview of the more general and more widely used techniques for residential water conservation: economic incentives, building code provisions, and public education programs.
W83-03716

3E. Conservation In Industry

ECONOMICAL WATER USE AND RECOVERY OF VALUABLE MATERIALS BY MEANS OF ION EXCHANGERS IN THE SURFACE FINISHING INDUSTRY (WIRTSCHAFTLICHE WASSERVERWENDUNG UND WERTSTOFFRUCKGEWINNUNG DURCH IONENAUSTAUSCHER IN DER OBERFLACHENVEREDELNDEN INDUSTRIE),
K. Fischwasser.
Wasserwirtschaft-Wassertechnik, Vol 32, No 8, p 260-263, August, 1982. 8 Fig, 3 Tab.

Descriptors: *Water use efficiency, *Water conservation, *Metal-finishing wastes, *Ion exchange, *Waste recovery, Water treatment facilities, Drinking water, *German Democratic Republic, Metal-finishing industry, Cation exchange, Anion exchange, Wash water, Nickel, Economic aspects, Costs, Recycling, Wastewater renovation, Wastewater treatment, Desalination, Industrial water.

The economical use of water is important in the chemical and electrochemical metal surface-finishing industries, both to minimize the consumption of drinking water for industrial purposes and to recover constituents of wastewater for conservation and environmental reasons. In the German Democratic Republic (GDR), ion exchange has been

used for this purpose. The purpose has been used successfully since 1968 for wash water desalination and wash water circulation management. For salt concentrations of 1-3 mmol/1 and two-level load, water savings of about 3.5 million cu m/yr for approximately 50 ion exchange facilities are realized (a saving of 95% of circulating water volume). The capacity of individual plants lies between 3 and 225 cu m/hr; the plant with the highest capacity is the Halle drinking water treatment facility, which exports water to the USSR. The disadvantage of ion exchange is that it requires regenerating chemicals, which can in themselves cause pollution; methods of reducing their use include reduction of wash water salt content, counterflow ion exchange with a cation exchanger, and compound regeneration between strong and weak basic anion exchangers. Two ion exchangers for nickel recovery have been operational since 1981 in Dresden. These plants could also be used to recycle other metals, such as copper and zinc with acid electrolytes. Ion exchange without recycling electrolysis is presently being instituted in the GDR. In the GDR, there are 20 facilities for phosphoric acid regeneration (iron removal) using acid cation exchange resins. Ion exchange, together with other procedures, is being tested for use in chromic acid recycling. (Gish-FRC)
W83-03521

INDUSTRIAL WATER REUSE WITH COUPLED-TRANSPORT MEMBRANES,
Bend Research, Inc., OR.
For primary bibliographic entry see Field 5D.
W83-03604

3F. Conservation In Agriculture

DREDGED SEDIMENT FOR AGRICULTURE: LAKE PARADISE, MATTOON, ILLINOIS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
W. D. Lembke, J. K. Mitchell, J. B. Fehrenbacher, and M. J. Barcelona.
Illinois Water Resources Center Research Report No 175, January 1983. 42 p, 13 Fig, 11 Tab, 21 Ref, 3 Append.

Descriptors: *Lake sediments, *Soil-water-plant relationships, *Dredging, *Agriculture, *Crop production, Economic yield, Corn, Water quantity, Water supply, Sediments, Nutrients, Potential water supply, Farming, Dewatering, *Illinois.

Sediment was hauled from Lake Paradise, a water supply lake for Mattoon, Illinois, applied to a demonstration site of farmland on the lake watershed. The sediments in the upper portions of the lake contained levels of trace metals which were very near the north hemispheric average for soils. The sediments were also balanced in nutrients and lower in total metal levels than some commercial soil amendments, resulting in a composition most closely comparable to the soil and cow manure. Results of the application showed a significant yield increase of corn on the hauled sediment plots compared to the original farmland. About a $100 per acre net increase resulted, which would help defray some costs of lake reclamation. It was found that the costs of lake reclamation by applying dredged sediment to farmland using terraces is directly related to the steepness of the land slope. Spray irrigating sediment was found to be comparable in cost to storing behind terraces, with the disadvantage that spray irrigation is limited to soils or special soil management practices where erosion can be controlled. A study of the water chemistry of Lake Paradise during the dredging operation indicated that the project had a minimal effect on lake water quality. Frequently, the limiting process in dredging operations is the rate of dewatering of the dredged materials. If certain admixtures of soil amendments can be used to improve dewatering properties, then using dredged material to reclaim agricultural soils can be optimized. (Garrison-Omniplan)
W83-03558

OPTIMUM WATER USE IN FRUIT CROP PRODUCTION,
Southwest Missouri State Univ., Springfield. Dept. of Agriculture.
B. D. Fuqua.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243089, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Missouri, Columbia, November 1982. 32 p, 4 Fig, 6 Tab, 16 Ref, 3 Append. B-130-MO(1), 14-34-0001-9080.

Descriptors: Irrigation, *Irrigation requirements, *Irrigation efficiency, *Drip irrigation, Soil water, *Water stress, Leaf-water potential, Soil-water potential, Saturated soil, Tensiometer, Fruit crops, Water use efficiency, Strawberries, Blueberries, Fragipan soils, Newtonia soil, Viration soil, *Soil water tensions, *Missouri, Springfield.

The effect of varying soil water tensions of the growth of strawberry (Fragaria annanassa) and highbush blueberry (Vaccinium corymbosum, V. australe) plants were studied in growth chamber and field experiments. Plants, grown in porous media in growth chambers, were more vigorous, had larger leaf areas, and higher xylem potentials when the media was maintained at high moisture contents. Visual symptoms of plant stress were evident in plants grown at soil water tensions above 0.80 bar. In the field studies, highbush blueberry plants made maximum growth in well drained, well aerated , moist soil conditions. Vegetative growth during the first two years of plant establishment was not significantly different as long as soil water tensions remained less than 0.65 bar. Blueberry plants grown in soils that remained wet for extended period of time made very little or no growth. The use of sawdust and/or wood shavings as surface mulches were beneficial in maintaining soil water tensions of less than 1 bar throughout the growing season. A drip irrigation system was effective in maintaining a soil water tension of 0.30 to 0.65 bar, a range that appears to be optimum for strawberry and blueberry plants. Sporadic rainfall and vast differences in drainage of soils make it difficult to define an irrigation schedule to encompass all soil conditions encountered in production of small fruit crops. Monitoring soil water tensions by use of tensio-meters was an effective method of checking water content in the moisture range needed for growth of strawberry and blueberry plants. Utilization of instruments to monitor soil moisture should result in conservation of energy, water, and labor required in growing small fruit crops.
W83-03669

EVAPORATIVE COOLING BY MIST AND SPRINKLE IRRIGATION AND CONSERVING WATER IN VEGETABLE IRRIGATION IN ARIZONA,
Arizona Water Resources Research Center, Tucson.
A. J. Pratt, and F. C. Harper.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-248328, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, January 1983. 20 p, 7 Fig, 6 Tab, 14 Ref. OWRT A-101-ARIZ(2), 14-34-0001-1103.

Descriptors: Vegetables, *Evaporative cooling, *Water conservation, Irrigation systems, *Sprinkle irrigation, *Mist irrigation, *Arizona, Water use efficiency, *Crop response, Crop yield, Peppers, Tomatoes, Potatoes.

Temperature, yield response and water-use efficiency are given for eight cultivars of peppers, two of tomatoes and one of potatoes irrigated by deadlevel furrow, regular and intermittent rotating sprinkling and micromist with bare soil, with black plastic mulch alone, and with clear plastic tunnels plus black mulch for the first three weeks after setting the plants. Peppers responded very well to both the black plastic mulch and the clear plastic tunnels plus the mulch, with significant total yield increases and water-use efficiency increases. Tomatoes gave both yield and water-use efficiency increases for the plastic mulch but not the tunnels. Potatoes also responded well for the black plastic mulch. Micromist resulted in the highest water-use efficiency (yield/cm of water applied). Graphs show the cooling effect of intermittent sprinkling on pepper fruits, potato foliage and soil 10- and 15-cm deep under pepper and potato plants.
W83-03729

STATISTICAL ANALYSIS OF CROP YIELD CONTROLLED LINE-SOURCE IRRIGATION,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
E. Bresler, G. Dagan, and R. J. Hanks.
Soil Science Society of America Journal, Vol 46, No 4, p 841-847, July/August, 1982. 4 Fig, 3 Tab, 9 Ref.

Descriptors: *Irrigation practices, *Crop yield, *Statistical analysis, Mathematical studies, *Line-source irrigation, Spatial variability, *Variagram, Corn, Wheat.

Analysis was made of the statistical spatial structure of the crop yield of an agricultural field due to variability of various factors influencing it. It is demonstrated that by operating with the scaled variable one can filter out the trend imposed by the variable water application volume and therefore reveal the influence of other factors such as soil properties and genetic and experimental errors. The major conclusions were, first, that a stationary, well-behaved varigram achieved for the yield is scaled with respect to its average at a given irrigation level. The average depends strongly on the irrigation level. Second, the variability of yield related to factors other than soil properties is small. Third, soil variability may have a much larger effect upon yield. Fourth, the latter has a spatial structure which has to be inferred in order to carry out statistical analysis of the field. The average and variance depend in this case on the size of the field. (Baker-FRC)
W83-03753

HEAVY WATER TRACING OF SOIL-WATER TRANSFERS UNDER IRRIGATION,
CEA Centre d'Etudes Nucleaires de Cadarache, Saint-Paul-les-Durance (France). Service de Radio-Agronomie.
For primary bibliographic entry see Field 2G.
W83-03755

A MODIFIED LINE SOURCE SPRINKLER TECHNIQUE FOR CONTINUOUS-VARIABLE LEACHING STUDIES,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
J. C. Stark, W. M. Jarrell, and J. Letey.
Soil Science Society of America Journal, Vol 46, No 2, p 441-443, March/April, 1982. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Sprinkler irrigation, *Leaching, Infiltration, Permeability, Soil water, Water supply, Fertilizers, Pesticides, Irrigation programs, Irrigation.

An irrigation system was designed which can produce a continuous range of leaching fractions. The leaching variable is produced by supplementing standard sprinkler irrigation with line source irrigation. The advantages of this modified line source technique include the capability of applying a continuous leaching variable to plots receiving uniform applications of sprinkler applied fertilizers or pesticides, the ability to adjust the slope of the water application gradient to produce the desired range of leaching fractions, and the option of a backup irrigation system when wind speed is too great for line source irrigation. By applying a chemical injector at the head of the main line, this system can also be used to apply uniform amounts of sprinkler applied fertilizers, herbicides, or insecticides to plots which receive line source irrigation. This technique could thus be used in studies designed to compare the effectiveness of surface applied and injected chemical sources at different levels of leaching. (Baker-FRC)
W83-03767

WATER AND ENERGY CONSERVATION IN IRRIGATED AGRICULTURE: AN ARID AREA TECHNOLOGICAL AND ECONOMIC CASE STUDY,
Arizona Univ., Tucson.
J. C. Wade.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-248377, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Tucson, Ariz., July 1983. 43 p, 13 Tab, 26 Ref. OWRT B-094-ARIZ(3), 14-34-0001-1202.

Descriptors: *Irrigation efficiency, *Economic efficiency, Cost-benefit analysis, Groundwater, Energy, Linear programming, *Arizona, Water conservation, Energy conservation, Prices, Water policy.

Conservation, efficiency and optimization go hand in hand in irrigated agriculture. Water and energy in Arizona agriculture is utilized in relationship to the efficiency of existing technology or technology that can be utilized by investing additional capital. Programs, policies and prices are the major factors influencing the use of water and energy. In Southern and Central Arizona substantial incentives exist from all three to encourage wiser and more efficient utilization of irrigation resources. Four case studies and an initial conceptualization summarize the potential short and long term effects on Arizona's irrigated agriculture. The increasing cost of irrigation water pumped in Arizona and the policies enacted by the State have created a new environment in which water can not be treated as a free good. Investment in laser leveling of fields and large scale linear move sprinkling irrigation systems seem to offer the best alternatives to keep irrigation cost in line with long term profitability. At any rate it can be expected that irrigated acreage in most areas of the state will decrease as will the net returns from irrigated farming. The changes will be uneven as areas of larger pump lifts and shorter growing seasons adapt differently. The basic resource endowment of soil, climate, and groundwater are fundamental in assessing the impacts of change. But equally important is human resourcefulness and captial expenditure. Conservation as a response to economic incentives prove to be as important as the policies enacted by the State. Work will continue based on the data collected and models designed from this research. This data will be organized and systematic analysis of policies and programs affecting irrigated agriculture will continue.
W83-03773

CONSTANT-FLUX INFILTRATION FROM A HEMISPHERICAL CAVITY,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W83-03782

SELECT HARDY PASTURE FOR DROUGHT SURIVAL.
New Zealand Journal of Agriculture, Vol 145, No 6, p 12-13, December, 1982.

Descriptors: *Pastures, *Drought resistance, Grasses, Legumes, Clover, Grazing, *New Zealand.

Pasture species suitable for use in drought conditions in New Zealand are identified. The ryegrass cultivars, Nui and Ellet, show the least drop in production and best persistence in stressful summer conditions. The properties and conditions for growth of other grasses and clovers are discribed. (Cassar-FRC)
W83-03789

IRRIGATION FUNDING NOW MORE RATIONAL,
For primary bibliographic entry see Field 6F.
W83-03811

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

RIVER MANAGEMENT RESEARCH NEEDS,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 6B.
W83-03601

HYDRILLA MANAGEMENT IN NORTH CAROLINA.
In: Proceedings, Workshop May 4, 1982, Raleigh, NC. Water Resources Research Institute, North Carolina State Univ., Raleigh, July 1983. 43 p, Witzig, A., Heimerman, J., and Partington, B., ed.

Descriptors: *Aquatic weeds, *Aquatic weed control, *Management, Planning, Lakes, Rivers, Ponds, *Herbicides, Physical control, Mechanical control, Fish, Proceedings, *North Carolina, Biocontrol.

This publication is a compilation of papers presented by hydrilla experts from around the Southeast during a workshop held on May 4, 1982. Hydrilla is a fast-growing aquatic weed that develops dense mats of vegetation which can choke irrigation systems and restrict boating, fishing, and swimming. The workshop was held to obtain a better understanding of hydrilla and the potential problem it poses to surface waters in North Carolina; to review the management efforts of other states and agencies; to evaluate approaches needed to develop a hydrilla management program for this state; and to determine additional research and educational needs. To those ends, papers were presented on such topics as the biology of hydrilla, the status of this plant in North Carolina, and alternatives for control. These topics and others are covered in this publication. Papers are included on chemical, physical, mechanical, and biological control. Also provided is information on the hydrilla management programs of Florida and South Carolina, and the hydrilla contingency plan for the Tennessee Valley Authority watershed. The research program and activities of the U.S. Army Corps of Engineers are also presented. Finally, there is a summary of the research and control needs for North Carolina.
W83-03616

CONSERVATION ASPECTS OF TWO RIVER IMPROVEMENT SCHEMES IN THE RIVER THAMES CATCHMENT,
K. G. Weeks.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 6, p 447-458, December, 1982. 5 Fig, 5 Tab, 2 Ref.

Descriptors: *Environmental effects, *Aquatic habitats, *Channel improvement, Fish, Conservation, Habitats, Dredging, Roding River, Stort River, Flood control, Aquatic plants, Vegetation, Revegetation, Banks, Stream banks, Grasses, Wildlife.

This paper reviews the conservation projects carried out on the rivers Stort and Roding, Lea Division, Thames Water Authority, during 1978-81. A flood alleviation scheme was built on the Stort to protect Bishop's Stortford from damages of a 70-year flood. The dredging and widening of the river was done from the water to minimize damage to trees and bank plants and animals. Tip sites were planted with 1/3 standard trees and 2/3 whips, doubling the number of trees at no extra cost. Selected areas were not reseeded to permit indigenous plant species to revegetate the sites. Natural wetlands were protected from damage. The Abridge flood alleviation scheme on the river Roding involved remodeling of an old brick and arch bridge and river works. The original river bed was preserved wherever possible. When extreme meanders had to be eliminated, new artificial cavities were constructed to provide fish cover. Within 2 years the bank plants and animals had recolonized. However, kingfisher and sand martin nesting sites had been lost. A survey of fish populations before and after river works showed an overall increase. (Cassar-FRC)
W83-03646

INTEGRATION OF MANAGEMENT METHODS WITH THE LIFE CYCLE AND ECOLOGY OF THE FILAMENTOUS ALGA, PITHOPHORA,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
S. W. O'Neal, D. F. Spencer, and C. A. Lembi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243196, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 154, April 1983. 62 p, 22 Fig, 34 Ref. OWRT B-119-IND(1).

Descriptors: Algae, *Nuisance algae, *Algal control, Algal growth, Algicides, Germination, Aquatic productivity, Copper sulfate, *Chlorophyta, *Pithophora, *Indiana, Water pollution control.

Pithophora oedogonia is a green filamentous alga. It is a free floating organism forming thick, heavy mats of vegetation that can fill in small impondments. It is generally a serious management problem because of its apparent resistance to standard algicides. In Indiana the alga overwinters as vegetative filaments and akinetes (nonsexual, thick-walled spores). Akinetes comprise approximately 21% of the overwintering free-floating biomass. Akinetes and overwintering filaments germinate to produce new vegetative filaments in the spring in response to an increase in water temperatures and a replenishment of nutrients. Net photosynthesis increases from a low in midwinter to a high in mid June and July. Biomass accumulation peaks in late September - early October. Akinetes are also present on the bottom sediments. Their germination occurs approximately a month after germination of akinetes in free-floating mats. The spring akinete germination period is critical because this is the time when most algicide treatments are made. This study shows that germination and initial germ tube elongation are dependent on the respiration of internal stored materials and are simazine-insensitive. Germinating akinetes are also relatively insensitive to copper sulfate. The inherent tolerence of germinating akinetes to simazine and copper sulfate plus the extended germination period due to sediment akinete germination may be a major reason the ineffectiveness of spring algicide treatments. Other alternatives such as copper treatments in late winter prior to akinete germination are being explored.
W83-03680

ENGINEERING WETLANDS: CIRCULATION, SEDIMENTATION, AND WATER QUALITY,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W83-03693

TECHNOLOGY TRANSFER PROGRAM: URBAN STORMWATER MANAGEMENT IMPLEMENTATION IN IOWA,
Iowa State Univ., Ames. Dept. of Civil Engineering.
R. L. Rossmiller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246454, Price codes: A05 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute Completion Report No 132, March 1983. 100 p, 7 Fig, 2 Tab, 9 Ref. OWRT A-082-IA(1), 14-34-0001-2117.

Descriptors: *Detention reservoirs, *Hydraulic design, *Hydrographs, *Land use, *Planning, *Urban hydrology, Culverts, Design floods, Legal aspects, Model studies, Multipurpose reservoirs, Storm sewers, *Storm water, Watersheds, *Iowa, Outlet structures, Watershed planning.

The objective of the recently completed Iowa Urban Stormwater Management Program was to make stormwater management an integral part of the activities of planners, engineers and politicians in existing urban areas and in new developments around metropolitan areas. Included in this overall objective were the legal institutional, planning and technical aspects of stormwater management. Two concurrent studies were undertaken at the University of Iowa and at Iowa State University. The studies at the University of Iowa Law College concentrated on the legal and institutional aspects of urban stormwater management: how it is being implemented around the United States, what is possible under existing Iowa law, the development of model ordinances, and various methodologies for funding the construction and maintenance of stormwater facilities. The studies at Iowa State University concentrated on the planning and technical aspects of urban stormwater management: planning on both a watershed and an individual development basis, the use of both structural and non-structural measures, and the effectiveness of on-site and off-site engineered facilities for both the primary and major systems. Emphasis was placed on the design of storm sewer systems and on the design of stormwater detention basins: various methodologies for the development of inflow hydrographs, the physical characteristics of basins for the development of stage-volume curves, and the hydraulics of several types of outlet structures for the development of stage-outflow curves. The results of these studies are contained in a planning and design manual.
W83-03696

4B. Groundwater Management

ARTIFICIAL GROUNDWATER RECHARGE, SAN LUIS VALLEY, COLORADO,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
D. K. Sunada, J. W. Warner, and D. J. Molden.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-227371, Price codes: A07 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report No 123, Colorado State University, Fort Collins, March 1983. 140 p, 39 Fig, 8 Tab, 33 Ref, 2 Append. OWRT A-050-COLO(1), 14-34-0001-1106 & 2106.

Descriptors: *Artificial recharge, *Computer models, *Groundwater recharge, *Mathematical models, *Colorado, San Luis Valley, Groundwater depletion, Aquifers, Computer programs, Microcomputers, Graphics display.

Intense use of aquifers for irrigation waters has caused groundwater storage depletion in many areas of the arid and semi-arid west, including the San Luis Valley in south central Colorado. Artificial recharge is a means of alleviating this problem. To show the practical benefits of artificial recharge to local water users, a demonstration recharge basin was operated in the San Luis Valley. Both numerical and analytical models were calibrated to the aquifer response to suggest operational policies. Analysis of the results of the demonstration project indicate that if recharge operations are conducted during the non-irrigation season when excess water is available, significant amounts of water can be added to storage and combat groundwater depletion. One difficulty with the use of models is that the results obtained are hard to visualize by non-technical persons. Recently a wide variety of microcomputers have become available which are relatively inexpensive and have the capability of readily evaluating solutions which describe groundwater response to artificial recharge. Their portability and graphics features make them excellent demonstration tools. As part of this study, a computer program was written which uses Glover's (1960) solution for recharge from a rectangular basin to model artificial recharge. The program is totally interactive, extremely user friendly, and runs on an Apple II+ 48K microcomputer. The model describes groundwater response to artificial recharge in an infinite, homogeneous aquifer and in a stream aquifer system and can also calculate discharge into a stream. The model is designed for use by both technical and non-technical persons, and is an excellent means of transferring knowledge from groundwater hydrologists to water users. The microcomputer model developed in this study could be used in other parts of the San Luis Valley to evaluate the benefits of artificial recharge in these other areas.
W83-03562

USE OF FERRUGINOUS GROUNDWATERS TO AUGMENT STREAMFLOW,
For primary bibliographic entry see Field 5G.
W83-03577

INJECTION AND THERMAL BREAKTHROUGH IN FRACTURED GEOTHERMAL RESERVOIRS,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 2F.
W83-03585

A RIVER BASIN NETWORK MODEL FOR CONJUNCTIVE USE OF SURFACE AND GROUNDWATER: PROGRAM CONSIM,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W83-03596

IMPACT OF ARTIFICIAL RECHARGE ON GROUNDWATER QUALITY OF GYPSUM AQUIFER IN HARMON COUNTY, OKLAHOMA,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W83-03607

ENGINEERING AND LEGAL RAMIFICATIONS OF GROUNDWATER CONTAMINATION - A CASE STUDY,
Dufresne-Henry, Inc., Concord, MA.
For primary bibliographic entry see Field 5G.
W83-03626

WATER BALANCE OF THE PEARL HARBOR-HONOLULU BASIN, HAWAII, 1946-1975,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
T. W. Giambelluca.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243121, Price codes: A08 in paper copy, A01 in microfiche. Technical Report No 151, May 1983. 149 p, 41 Fig, 65 Tab, 203 Ref, 2 Append. OWRT A-089-HI(1), 14-34-0001-1113.

Descriptors: *Water balance, *Groundwater recharge, *Precipitation, *Runoff, *Evapotranspiration, Irrigation, Pearl Harbor Basin, Honolulu Basin, Sugarcane irrigation, Lawn irrigation, Fog drip, *Hawaii.

The basal aquifer underlying the Pearl Harbor-Honolulu Basin comprises the principal source of water supply for municipal demands of greater Honolulu and the demands of irrigated agriculture. Declining freshwater head and increasing chlorinity of coastal well water have led to recent groundwater development controls in the area. Determination of the sustainable (safe) yield of the basin requires a spatially and temporally detailed estimate of the recharge. The water balance of the basin was computed for 258 discrete zones at a monthly interval over the 1946 to 1975 (360 months) period. Results of the analysis include estimates of monthly precipitation, fog drip, sugarcane irrigation, urban lawn sprinkling, runoff, evapotranspiration, and groundwater recharge for each zone. The average recharge rate of the critical Pearl Harbor region was found to be 11.74 m super 3/s (268 mgd), of which 2.98 m super 3/s (68 mgd) is derived from the return of applied irrigation water. Results indicate that the groundwater resources of the basin are sufficient to support a population increase of approximately 450,000, should sugarcane and pineapple cultivation be discontinued.
W83-03673

A COMPARATIVE EVALUATION OF GROUND-WATER MANAGEMENT TECHNIQUES,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
J. L. Emel, J. M. Dworkin, T. Maddock, III,, and M. Bradley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246538, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Tucson, Arizona, July 1983. 54 p, 2 Tab. OWRT B-081-ARIZ(1), 14-34-0001-0204.

Descriptors: *Water management, *Water law, Aquifer management, *Groundwater management, Western U.S., Water policy, Water supply.

A summary and evaluation of groundwater supply management programs inthe western United States is presented. Statutes, district manadates, and court decisions set out general objectives which are interpreted and implemented by administrative agencies. While the objectives are for the most part philosophically derived, the implementation mechanisms are the result of both philosophic interpretation and hydrologic science. As established in this research, the objectives of state and district groundwater supply policies are property rights protection and aquifer development management. The former relates to protection of access, and the latter to planned depletion or conservation goals (i.e., 'safe yield'). Various management appoaches are discussed which reflect the variety of interpretations and emphasis given these objectives by the various agencies. The differences in and impacts of groundwater management tools in western states are investigated toward understanding the tradeoffs in selection of management criteria and procedures. A hydrologic response model is used to illustrate the conclusions.
W83-03704

INSTITUTIONAL FRAMEWORK FOR CONJUNCTION USE OF SURFACE AND GROUNDWATER IN TUPELO-LEE COUNTY, MISSISSIPPI: PHASE II,
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
R. E. McArthur, and D. B. Brammer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249623, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, April 1983. 52 p, 34 Ref. OWRT A-137-MS(1), 14-34-0001-2126.

Descriptors: *Management, Planning, *Institutional constraints, *Conjunctive use, Groundwater management, Water supply, Groundwater availability, Surface water availability, *Mississippi, Tupelo-Lee County.

Excessive pumping of groundwater in Lee County, Mississippi, has caused a serious lowering of the water table. An engineering study has recommended that the area take action to alleviate this situation through conjuctive use of groundwater and surface water. Experience in other areas has shown, however, that there are often institutional barriers to the intergovernmental water planning and management necessary for conjunctive use. It is feared by some observers that similar obstacles might frustrate the effective realization of the engineering recommendations. The research focused upon the modification of intergovernmental patterns to provide conjunctive use for Lee County. The research objectives were based upon the assumption that Lee County institutional arrangements must evolve if local and regional officials are to manage the emerging water problem. The research objectives were (1) to analyze current relevant institutional arrangements which affect water resources planning and management in Lee County; (2) to present a Model Institutional Framework for modifications in these existing arrangements to encourage conjunctive use: and (3)

to propose a program of action to implement the Model Institutional Framework.
W83-03721

USE OF NATURAL UNDERGROUND RESERVOIRS FOR CONTROL OF SURFACE RUNOFF,
Ukrainskii Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Kiev (USSR).
B. P. Karuk, and A. N. Aliferov.
Water Resources (English Translation), Vol 9, No 2, p 169-171, March-April, 1982. 4 Fig, Translated from Vodnye Resursy, No 2, p 79-82, March-April, 1982.

Descriptors: *Water supply development, *Underground storage, Water supply, *USSR, Ukraine, Water quality control, Runoff, Water storage, Artificial recharge.

Various studies have been conducted in the USSR to examine the possibility of artificial replenishment of groundwaters and creation of underground reservoirs in a number of regions in the Ukraine. The geological and hydrogeological conditions of the Crimean plains permit creating here large underground reservoirs with a total volume of about 1.5-2.0 cubic kilometers. All water surpluses of the North Crimean Canal can be fed into the underground horizons composed of porous, fractured limestones. Depending on the water quality in the source and requirements imposed by various consumers on water from underground reservoirs, two approaches to the problem of conditioning water being fed into the underground horizons are possible. First, all water purified to the required degree of quality. Secondly, water is fed directly without pretreatment or with medium treatment to remove suspended material in settling ponds or in the rock stratum. This is possible under the following conditions: the water from the underground reservoirs is used mainly for irrigation or industrial water supply; there is no threat of polluting adjacent aquifers which are the source of domestic potable water supply; and there is no threat of clogging and additional pollution of the enclosing rocks. With consideration of imminent water management problems in a number of regions of the country it is expedient to accelerate a study of the feasibility and creation of underground reservoirs. (Baker-FRC)
W83-03758

EFFECT OF MOWING HEIGHT UPON CONSUMPTIVE WATER USE, GROUNDWATER RECHARGE AND RECHARGE QUALITY FROM BERMUDAGRASS WATERED WITH SECONDARY TREATED EFFLUENT,
Arizona Univ., Tucson. Dept. of Plant Sciences.
W. R. Kneebone.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-253286, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Tucson, Arizona, July 1983. 7 p, 2 Tab, 8 Ref. A-115-ARIZ(1), 14-34-0001.

Descriptors: *Consumptive use, Pan evaporation coefficients, Bermudagrass turf, Mowing height, Zeolite effluent, Groundwater recharge, Water quality, Sewage treatment.

Tifgreen bermudagrass was grown on three soil mixes (washed mortar sand, 95 sand - 5 zeolite, 90 sand, 10 zeolite) under three scheduled mowing heights (12.5, 25.4 and 37.5 mm) and irrigated with secondary sewage effluent at 100% Class A Pan evaporation (less rainfall) twice each week. Because of certain growth problems the height differentials were not fully established the first year, but water use was consistently less over the period June 1982 - June 1983 for the 12.5 mm height treatment than for the other two. Adding zeolite had no apparent effect on water use. Water use averaged 63% of pan over the first year of the experiment with the 12.5 mm treatment at 60 and the other two averaging 64. Leachate samples from all plots were analyzed at the end of the first bermudagrass season. They were free of nitrogen (same values as blanks). At the level of irrigation used the turf had unthrifty growth suggesting limited nutrient availability. The turf received no nutrients other than those supplied by the effluent.
W83-03816

4C. Effects On Water Of Man's Non-Water Activities

THE IMPACT OF URBANIZATION ON A FLOOD-PLAIN AQUIFER: BLOOMINGTON, INDIANA,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W83-03609

PREDICTING INFILTRATION AND SURFACE RUNOFF FROM RECONSTRUCTED SPOILS AND SOILS,
Kentucky Water Resources Research Inst., Lexington.
L. G. Wells, A. D. Ward, and R. E. Phillips.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235523, Price codes: A04 in paper copy, A01 in microfiche. Research Report No 143, July 1983. 55 p, 21 Fig, 7 Tab, 31 Ref. OWRT B-078-KY(1), 14-34-0001-1299.

Descriptors: *Infiltration, *Infiltration rate, Infiltration capacity, Runoff, *Runoff rates, Soil water, Soil water potential, *Kentucky, *Spoils, Spoil water, Spoil water potential.

A laboratory system was fabricated to measure infiltration and runoff from spoil and soil profiles constructed in rectangular bins. Construction, calibration and operation of a rainfall simulator is discussed and instrumentation used to measure transient infiltration and transmittance of water through experimental profiles is described. Spoil and soil materials from surface mines in Eastern and Western Kentucky were transported to the laboratory and used in constructing experimental profiles in rectangular bins. An extensive series of infiltration experiments were conducted utilizing a rainfall simulator and soil moisture monitoring instrumentation. A dual probe gamma density guage was used to measure moisture content and tensiometers were used to measure soil matric suction. Initial moisture content, bulk density and rainfall rate were varied and respective responses of infiltration characteristics determined. Extremely low infiltration rates in Western Kentucky spoil material was attributed to relatively high bulk densities and well-graded particle constituency. Conversely, extremely high infiltration rates were observed for Eastern Kentucky shale material even at very high bulk densities. The sandstone material, however, exhibited infiltration rates of the same order of magnitude as that of Western Kentucky spoil material. Soil water characteristic curves were developed using the Brooks-Corey and Gardner procedures, based upon desorption tensiometer data. Unsaturated hydraulic conductivity values were determined using the 'plane of zero flux' procedure and compared with predictions resulting from models described by Campbell, Burdine and Mualem for situations involving 'reconstructed' soil and spoil materials.
W83-03610

4D. Watershed Protection

CONSERVATION ASPECTS OF TWO RIVER IMPROVEMENT SCHEMES IN THE RIVER THAMES CATCHMENT,
For primary bibliographic entry see Field 4A.
W83-03646

THE EFFECTS OF FOREST HARVEST ON WATER QUALITY AND AQUATIC LIFE (PHASE I),
Arkansas Univ. at Monticello. Dept. of Natural Sciences.
E. J. Bacon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246413, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Publiction No 100, Univ. of Arkansas, Fayetteville, March 1983. 72 p, 1 Fig, 19 Tab, 1 Append. OWRT A-052-ARK(1), 14-34-0001-0104.

Descriptors: *Nitrogen, *Phosphorus, Water quality, Watershed, *Sediments, Ecosystems, *Species diversity, Management planning, *Small watersheds, Runoff, Sedimentation, Macroinvertebrates, Fish, Bioindicators, Standing crops, *Arkansas, Little Missouri River, *Clearcutting.

A long term study on the effects of clearcut forest harvest and regeneration was conducted in a representative watershed of the Ouachita National Forest. Fourteen water quality parameters were analyzed to characterize baseline water quality. Water quality was classified as excellent. A total of 350 quantitative benthic samples and 15 ultraviolet light trap samples yielded 173 species of macroinvertebrates. Mean densities of macroinvertebrates ranged from 4,800/m super 2 to 23,040/m super 2 in the upper Little Missouri River. Twenty-two quantitative collections of fishes were made at representative riffles and pools. The average biomass estimates for riffles and pools were 5.69 kg/ha and 16.66 kg/ha, respectively. The total numbers of individuals per hectare were higher in riffles than pools. Lower standing crops of fish were observed in a tributary stream to the main river. A Phase II study will evaluate and summarize the effects of clearcutting approximately 113.3 hectares of deciduous forest on water quality and aquatic life in the watershed.
W83-03686

LEGAL AND INSTITUTIONAL CONSTRAINTS AND OPPORTUNITIES IN WETLANDS ENHANCEMENT,
For primary bibliographic entry see Field 6E.
W83-03692

TOWARDS AN OVERALL STRATEGY IN DESIGNING WETLAND RESTORATIONS,
Sorensen (Jens) and Associates, San Diego, CA.
J. Sorensen.
In: Wetland Restoration and Enhancement in California, M. Josselyn, ed. California Sea Grant College Program Report No T-CSGCP-007, Tiburon Center for Environmental Studies, San Francisco State Univ., December 1982. p 85-96, 1 Fig.

Descriptors: *Wetlands, *Watershed management, *Environmental effects, *Regional development, *Resources development, Aquatic habitats, Wildlife habitats, Land use, Land tenure, Land classification, Cost-benefit analysis, Governmental interrelations.

In designing a program for restoring and enhancing wetlands in Los Angeles and Orange Counties, the author created a flow diagram which allowed for a systematic assessment of the entire restoration process. His flow diagram is for wetlands that are: 1) environmentally degraded relative to their former conditions; 2) partly or entirely in private ownership; and 3) unlikely to be restored without the infusion of private sector funds in a quid pro quo arrangement between public agencies and property owners. The majority of the approximately 110 discrete coastal wetlands in California fit these criteria. The first step in the process is to define the geographic area that will be affected by the restoration. Secondly, there should be statewide and regional analyses to identify the types and mixes of environmental factors that create optimal habitats for fish and wildlife. An impediment to the planning process is the definition of wetlands, degraded wetlands, and uplands; state, federal, and private property owners cannot agree on a definition and are in a debate over quantity versus quality of acreage. Actual ownership must also be determined. Another step is to determine the existing resource values and to establish base line data for monitoring and evaluation processes; however, this is a major problem for lack of a uniform classification system. A new

habitat and fauna classification system should be designed to indicate how they will be affected by restoration plans. A mapping system indicating type, location and density of activities and habitat would help set these regional goals. The last steps after implementation are to seek public review and comment and to evaluate the program. (Atkins-Omniplan)
W83-03695

SURFACE SOIL PHYSICAL PROPERTIES AFTER 36 YEARS OF CROPPING TO WINTER WHEAT,
Texas Agricultural Experiment Station, College Station.
For primary bibliographic entry see Field 2J.
W83-03805

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

COLIPHAGES AND COLIFORM BACTERIAIN RUNNING WATERS OF DIFFERENT QUALITY (COLIPHAGEN UND COLIFORME BAKTERIEN IN FLIESSGEWASSERN UNTERSCHIEDLICHER GUTE),
Universitaet des Saarlandes, Saarbruecken (Germany, F.R.).
U. Zaiss.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 15, No 4, p 171-177, August, 1982. 6 Fig, 2 Tab, 45 Ref. English abstract.

Descriptors: *Water quality, *Indicators, *Bacteria, Coliforms, Fate of pollutants, Coliphages, Biochemical oxygen demand, Ammonia, Phosphates, Municipal wastes.

Measurements were taken of the concentration of coliphages and coliform bacteria at 47 sampling stations of running waters in the city area and outskirts of Saarbrucken. The investigated streams were polluted to different degrees. In the water samples the numbers of coliphages and coliphages and coliform bacteria were compared with the numbers of saprophytic bacteria and levels of BOD, COD, ammonia and orthophosphate. A quality index was developed with these parameters which indicated numerically the degree of pollution. The values of all parameters increased with decreasing water quality. The concentration of coliphages correlated well with that of coliform bacteria and orthophosphate. According to these results coliphages are suitable to indicate fecal pollution. However, these measurements were made during the season of high, uniform flows; correlations might not be as good in the case of marked flow variations. Coliphage determinations are primarily suitable for rapid (5 hr) detection of viral pollution, but they should not be used as a replacement for the direct detection of Escherichia coli in drinking water, a process which requires 2-3 days. (Baker-FRC)
W83-03513

ENTEROCOCCI AND OTHER MICROBIAL INDICATORS IN MUNICIPAL WASTEWATER EFFLUENTS,
Food and Drug Administration, Davisville, RI. Shellfish Sanitation Branch.
J. J. Miescier, and V. J. Cabelli.
Journal of the Water Pollution Control Federation, Vol 54, No 12, p 1599-1606, December, 1982. 1 Fig, 8 Tab, 36 Ref.

Descriptors: *Indicators, *Bacteria, *Wastewater analysis, Pollutant identification, Monitoring, Sewage bacteria, Chlorination, *Wastewater treatment, Effluents, *Enterococci, Coliforms, Enteric bacteria, Recreation, Swimming, Viruses.

Enterococci best satisfied the requirements for a microbial indicator in wastewater effluents. Samples collected from 9 municipal wastewater treatment plants in Rhode Island after primary, secondary, tertiary treatment, and chlorination were examined for densities of enterococci, Escherichia coli, fecal coliform, total coliform, Pseudomonas aeruginosa, and Aeromonas Hydrophila. Densities of enterococci varied least from one plant to another and did not increase during primary or secondary treatment. This was not true of any other indicators tested. Mean enterococci densities (per 100 ml) were 190,000 after primary treatment; 11,000 after secondary treatment; and 1100 after tertiary treatment. Mean log 10 reductions in bacterial counts after chlorination were: fecal coliforms, 4.763; E. coli, 4.726; and enterococci, 3.573. These findings suggest that enterococci multiply little or not at all in transit to the plant and through the treatment process. They are more consistently related to the fecal wastes of the sewered population than the other organisms and may better simulate viruses with regard to chlorine sensitivity. (Cassar-FRC)
W83-03551

METHODOLOGY OF RESEARCH CONCERNING MICROPOLLUTANTS: BIOLOGICAL TESTS,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
C. L. M. Poels, M. A. van der Gaag, and A. Noordsij.
Water Science and Technology, Vol 14, No 12, p 143-152, 1982. 3 Fig, 4 Tab, 8 Ref.

Descriptors: *Testing procedures, Water quality, Wastewater treatment, Fish, *Biological tests, Mutagenicity, *Pollutant identification, *Bioassay, *Toxicity, Rhine River.

In order to obtain insight into the toxicological quality of polluted waters a broad range of test methods is available. Because of the wide variability in biological effects caused by the substances present in a complex polluted water, a well considered choice of biological methods is recommended. These biological methods should be supported by, and if possible strongly integrated with, chemical analysis. For detection of harmful effects of water containing numerous pollutants in low concentrations, long term as well as embryo/larval tests with rainbow trout are applied to measure chronic toxic effects. The very important genotoxic effects, however, are missed by these tests. For this purpose Sister-Chromatid exchange tests with eastern mud minnows and Ames tests are performed. Especially the last test can be fully integrated with analytical chemical methods. Thereby it will be possible in the near future to identify the mutagenic substances and to track down their origin. The findings of these various tests indicate that the Rhine is a heavily polluted river, according to not only chemical but also biological tests. The tests mentioned can also be used to improve water quality. (Baker-FRC)
W83-03554

ALTERNATIVE METHODS OF ESTIMATING POLLUTANT LOADS IN FLOWING WATER,
Wisconsin Dept. of Natural Resources, Madison.
K. Baun.
Technical Bulletin No 133, 1982. 11 p, 2 Fig, 9 Tab, 12 Ref.

Descriptors: *Water sampling, *Pollution load, *Stream pollution, *Monitoring, *Water quality standards, Streamflow, Water quality criteria, Water quality control, Urban runoff, Statistics, Statistical analysis, Mathematical studies, Runoff.

A comparison is provided of three principal methods of estimating pollutant loads in flowing water: integration; composite; and stratified random sampling, enhanced with ratio estimation. The latter is a relatively new approach to estimating pollutant loads. It enables an estimate of confidence limits to be placed upon the loading estimates, and also enables unsampled flows to be included in the loading estimates with some knowledge of the uncertainties involved. In addition, stratified random sampling can probably give accurate loading estimates with considerably fewer samples than would normally be required with integration, and will give better estimates than other simple statistical calculations. Two disadvantages of stratified random sampling are that it becomes proportionately more expensive if the number of samples is larger than would be required for composite analyses; and larger error terms than desired can result if the appropriate number of samples is not selected. Likewise, where integration works well, it does so only because the flows are extensively sampled and, hence, is very expensive. It does not enable an error term to be placed on the loading estimates, and it has limited applicability at new stations. Composite sampling may be very accurate and inexpensive when events are well sampled. Further, it allows for excellent inter-event analysis. The major drawback is a lack of an error term. (Garrison-Omniplan)
W83-03557

DEVELOPMENT OF A CHEMICAL ANALYSIS FOR ULTRATRACE ARSENIC IN WATER,
South Carolina Univ., Columbia. Dept. of Chemistry.
S. R. Goode.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-227421, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Publication No 101, Clemson Univ., S.C., May 1983. 41 p, 10 Fig, 1 Tab, 65 Ref. OWRT B-121-SC(2), 14-34-0001-9095.

Descriptors: *Arsenic, *Chemical analysis, *Drinking water, Concomitant effects, Enzymes, Fluorometry, Reaction rate determination, *Pollutant identification, Water analysis.

Arsenic is one of the most toxic elements known to man. The presence of arsenic at the 0.01 g/ml level (0.01 ppm or 10 ppb) is considered undesirable for drinking water. The water quality laboratory, however, is incapable of the detection of arsenic at these levels. Thus arsenic is seldom monitored and rarely part of a routine and comprehensive program of the measurement of water quality. A unique enzymatic method has been developed for the determination of As(V) in natural waters. The method uses arsenic to catalyze a chemical reaction which produces a fluorescent species. The method has a detection limit of 8 ng/ml. A detailed study of the mechanism and magnitude of interferences has been performed. The results indicate that only Fe super 3+ has the capability of causing erroneous results. This problem is avoided by masking with citrate.
W83-03567

NEW CORRECTION PROCEDURES FOR CHROMATE INTERFERENCE IN THE DPD METHOD FOR RESIDUAL FREE AND COMBINED CHLORINE IN WATER,
Newcastle and Gateshead Water Co., Newcastle-upon-Tyne (England).
A. T. Palin.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 5, p 351-353, September, 1982. 3 Tab, 9 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Chromate, Chromium, Titrimetry, Colorimetry, Barium chloride, Thioacetamide, Water quality, *DPD method.

Water samples were prepared containing free chlorine with added amounts of chromate. Determinations on samples containing chromate were carried out after first adding 0.2 g barium chloride crystals to the 100 ml test portion. The white suspension produced did not interfere with the end point detection. Results were similarly obtained for samples containing combined chlorine from added calcium hypochlorite and ammonium sulfate. Results obtained on samples at 24C containing both chromate and residual chlorine indicated that in terms of color development after thioacetamide treatment and standing for two minutes a concentration of 5 mg/liter Cr (6+) was equivalent to 0.1 mg/liter C1(2), a ratio which applied over the 5 to 50 mg/liter Cr (6+) range studied. In the application of the DPD method to waters containing chromate the following additional reagents are needed for

correction of any interference: barium chloride crystals in the titrimetric method and thioacetamide solution in the colorimetric method. (Baker-FRC)
W83-03579

GUIDELINES FOR SAMPLING GROUND WATER,
Texas Tech Univ., Lubbock.
G. F. Lee, and R. A. Jones.
Journal of the Water Pollution Control Federation, Vol 55, No 1, p 92-96, January, 1983. 11 Ref.

Descriptors: *Groundwater, *Sampling, *Monitoring, Planning, Acidity, Temperature, Chemical composition, Turbidity, Metals, Organic compounds, Specific conductivity, *Pollutant identification.

Guidance on how to develop suitable groundwater sampling programs by highlighting physical and chemical characteristics peculiar to groundwaters is provided, along with emphasis on reliable investigative technique. Chemical concentrations in groundwater can vary with duration of pumping and the period of time since the last pumping. Therefore, samples should be collected after a steady state condition has been reached in the sampling well. When a new well is developed for groundwater sampling purposes, it should be pumped vigorously until the water appears free of suspended solids. The well should be allowed to stand several days and then pumped again to flush it. If the water is clear, the well sampling program can begin. Groundwater monitoring wells should be positioned to monitor overall water quality characteristics of the groundwater in the region and both up and down the groundwater hydraulic gradient from suppected specific sources of contaminants such as waste disposal areas, sludge dewatering lagoons, contaminant storage areas, any sumps created to collect surface runoff, and others. Of particular concern are nearby wells used for domestic and agricultural water supply. The following parameters should be monitored: pH, temperature, specific conductance, turbidity, chloride, sodium, dissolved oxygen, calcium, magnesium, alkalinity, total organic carbon, dissolved organic carbon, soluble orthophosphate, ammonia, nitrate, arsenic, barium, beryllium, boron, cadmium, chromium, copper, fluoride, hydrogen sulfide, lead, mercury, nickel, potassium, selenium, and phenolic compounds. (Baker-FRC)
W83-03582

INVESTIGATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN WATER SYSTEMS,
Connecticut Univ., Storrs. Inst. of Water Resources.
S. R. Smith, J. Tanaka, R. Collins, and J. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235259, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, March 1983. 4 p, 4 Fig, 2 Tab, 4 Ref, 1 Append. OWRT A-084-CONN(2), 14-34-0001-9007.

Descriptors: *Aromatic compounds, *Hydrocarbons, Water pollution, *Impaired water quality, Testing procedures, Hazardous materials, Water sampling, *Pollutant identification, Water analysis.

The determination of Polycyclic Aromatic Hydrocarbons (PAH) in water systems has been of great importance due to the highly carcinogenic, and in several cases, mutagenic properties of some PAH and their degradation products. An extensive literature search was carried out prior to initiation of lab work. This search indicated a need for comparing and evaluating solvent concentration techniques. Concentration of methylene chloride or ethyl ether solutions containing PAH's by nitrogen evaporation or the use of Snyder column or stainless steel gauze columns proved to be the most accurate and precise methods. Recovery of PAH's from standard solutions containing 7 PAH's yielded average recoveries between 80 and 100% + or - 10%. Preconcentration of PAH from large volumes of water using Tenax-G.C. has also been studied. Fouling of the polymer bed by iron particles or other particulate matter and a general lack of precision for the method have proven to be difficult problems to overcome. Fouling by particulate matter can be overcome by the use of prefiltering agents such as Celite-545. Improvements in precision have not yet been realized. Preconcentrations using a micro method for liquid-liquid extraction of water solutions containing PAH has been attempted. Incomplete solvent recovery has prevented reliable results. Since the adsorption onto a porous polymer resin is more convenient for field studies, large scale liquid-liquid extraction has not been pursued.
W83-03591

RIVER BASIN WATER QUALITY MONITORING NETWORK DESIGN,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
F. S. Tirsch, and J. W. Male.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235275, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 141, Massachusetts University, Amherst, March 1983. 197 p, 35 Fig, 11 Tab, 135 Ref. OWRT B-080-MASS(1), 14-34-0001-1234.

Descriptors: *Monitoring, *Stream gages, *Gaging stations, *Water pollution, *Water quality, *Water measurement, Data collections, River basins, Streamflow, Steam improvement, Waste dilution, Connecticut River, Shoshone River, Massachusetts, Wyoming.

Anyone attempting to design a surface water quality monitoring network is faced with a paradox because the statistical parameters controlling the optimality of a monitoring network are often the unknowns that the network is being designed to estimate. Resolution of the paradox is to use an iterative approach. Initial design may be arbitrary or based on experience and is refined over time in successive iterations as more information is gathered. The authors' procedure utilizes multivariate linear regression techniques and relies on the regression corrected coefficient of determination, R super -2, as measure of network reliability. Spacial design is examined given water quality data at various monitored locations. Temporal design is examined given different sampling frequencies. Spacial and temporal analyses are combined to form the space-time trade-off for the river basin. In one example for the Millers River (Massachusetts) the trade-off for monitoring mean daily streamflow is developed. In a second example for the Shoshone River (Wyoming) the trade-off for the specific conductance quality parameter is developed. Monitoring costs and monitoring benefits are discussed functions of monitoring reliability. The optimum network design occurs at that reliability for which the difference between benefits and costs is a maximum.
W83-03593

A QUESTION OF SAMPLING,
Welsh Water Authority, Powys (Wales). Directorate of Scientific Services.
For primary bibliographic entry see Field 7B.
W83-03595

THE EFFECT OF STRESS ON ORGANISMS IN THE DISTRIBUTION SYSTEM,
Delaware Univ., Newark. School of Life and Health Sciences.
D. S. Herson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235440, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center Completion Report, Newark, January, 1983. 46 p, 7 Fig, 3 Tab, 40 Ref. OWRT A-050-DEL(1).

Descriptors: Chlorination, *Coliforms, Enterobacter, Escherichia coli, Inhibition, Water quality, *Delaware, Wilmington.

Water microbes were subjected to stresses found in the distribution system. Recovery of the coliform (Escherichia coli) but not the non-coliform (Chromobacterium sp.) was inhibited in the presence of the other organism, a chlorine residual or temperature shift. Inhibition was more pronounced when the coliform was grown in the presence of the non-coliform and either of the other two stresses. Inhibition of coliforms was again observed when Enterobacter cloacae was mixed with large numbers of the non-coliform Moraxella sp. and millipore filtered. Scanning electron microscopy of E. coli growing in the presence of low nutrient levels or in the cold indicated that cells under these conditions had an altered morphology when compared with controls. Using concentration and enriched procedures coliforms were not isolated from Wilmington Water Department finished water. Using acridine orange staining coupled with 2-(p-iodopheny)-3-(p-nitrophenyl)-5-phenyl-tetrazolium chloride reduction (AOINT) levels of total microbes detected in water samples were orders of magnitude greater than the levels detected by the Standard Plate Count (SPC). This method, which can be used to supplement the SPC, determined metabolically active bacteria in a water sample within four hours.
W83-03602

ENUMERATION OF CHLORINE-DAMAGED FECAL COLIFORMS IN WASTEWATER EFFLUENTS,
Illinois Univ. at the Medical Center, Chicago. School of Public Health.
For primary bibliographic entry see Field 5D.
W83-03632

SEASONAL LOSSES OF N SUB 2, H SUB 2S AND CH SUB 4 FROM SEDIMENTS TO THE ATMOSPHERE FROM WETLANDS IN THE ARROWWOOD NATIONAL WILDLIFE REFUGE, NORTH DAKOTA,
North Dakota State Univ., Fargo. Dept. of Zoology.
J. J. Peterka, and R. D. Nelson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249607, Price codes: A02 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State Univ., Fargo, June 1983. 9 p, 2 Fig, 1 Tab, 11 Ref. OWRT A-070-NDAK(1), 14-34-0001-0136.

Descriptors: *Manometers, *Methane, *Hydrogen sulfide, Gas chromatography, Sampling, Sulfur cycle, Carbon cycle, *North Dakota, *Pollutant identification, Wetlands, Arrowhead National Wildlife Refuge, *Dinitrogen, Gas sampling, Atmospheric pollution.

Methods are described for collection and analysis of dinitrogen (N sub 2), methane (CH sub 4) and hydrogen sulfide (H Sub 2S) produced in wetlands. Dinitrogen was present in all samples while methane and hydrogen sulfide were found not at all or in very small amounts. Problems with the sampling cones and collecting flasks may be responsible for the varying amounts of gases found in the samples. Correction of these problems is a primary area of concern and must be resolved before quantification can begin.
W83-03719

SAMPLING AND ANALYSIS OF INDUSTRIAL BENTHIC POLYNUCLEAR AROMATIC HYDROCARBONS IN INDUSTRIALIZED URBAN WATERSHEDS,
Alabama Univ. in Birmingham. Dept. of Chemistry.
R. L. Settine, and K. Burchfield.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249656, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Auburn Univ., Ala. April 1983. 13 p, 4 Fig, 2 Tab. OWRT A-087-ALA(1), 14-34-0001-2101.

Descriptors: *Industrial wastes, *Wastewater anlysis, Industrial wastewater, Urban watersheds, Hydrocarbons, *Alabama, Opossum Creek, Gas chromatography, Mass spectrometry, *Pollutant identification.

A method is reported for the sampling and analysis that accurately describes the contour and distribution of benthic polynuclear aromatic hydrocarbons of Opossum Creek. The analytical methodology consisted of using fused silica capillary chromatography coupled with selected ion mass spectrometry to identify and quantify areas of high concentration of specific benthic compounds. It is apparent from the 'grid technique' herein reported that this model can be applied for future stream system analysis and would be an extremely reliable aid for engineering decisions with regard to cleanup.
W83-03726

REPRESENTATIVE SAMPLING LOCATION CRITERION FOR RIVERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
T. G. Sanders.
Water SA, Vol 8, No 4, p 169-172, 1982. 3 Tab, 6 Ref.

Descriptors: *Mixing, Water quality, *Monitoring, Measuring instruments, Mathematical equations, *Sampling, Destratification, Rivers, Pollutant identification.

A quantitative criterion is presented for establishing zones of relatively complete mixing in a river. In order to effectively monitor water quality in a stream using only a single sampling point in the stream's cross section, the point being sampled should be within a zone of relatively complete mixinng. Using an analysis of variance procedure, the water quality concentration variation within a river's cross section can be analyzed to determine whether the variation is large, requiring more than one sampling point to obtain a representative sample, or small, establishing a completely mixed zone. Under most circumstances complete mixing will exist in the vertical direction prior to being completely mixed in the lateral transect, and the water quality variable concentrations will vary with time. If the variability of the concentrations in time were not taken into account in the analysis, the possibility would exist that the variability of the water quality concentrations at different locations in the lateral transect may be the result of time variability and not spatial variability. Water quality variable concentrations at just the midpoint of the river would not suffice, as the samples would not take into account the sewage effluents. Similaryly, water quality samples at either shore would not be representative, as the effluent concentrations of the sewage treatment plants would have a significant effect on the magnitude of the water quality concentrations. Therefore, it would appear that sampling at the third points of the lateral transverse would be the minimum number of sample locations to adequately define mean concentrations representative of the river's cross section at a location which is not within a zone of complete mixing. (Baker-FRC)
W83-03740

THE SUITABILITY OF M-ENDO-LES AGAR FOR TOTAL COLIFORM COUNTS BY MEMBRANE FILTRATION,
Johannesburg City Health Dept. Labs. (South Africa).
S. Lichtigfeld, and L. N. Melmed.
Water SA, Vol 8, No 4, p 173-177, 1982. 4 Tab, 14 Ref.

Descriptors: Water quality, *Pollutant identification, *Coliforms, Fecal contamination, Fate of pollutants, *Membrane filtration, Medium.

The media M-Endo-LES agar (M-LES) and M-MacConkey agar (M-Mac) were compared for carrying out coliform counts by membrane filtration on potable water samples. Notwithstanding some difficulties experienced with coliform differentiation on M-LES, it is still a more suitable medium than M-Mac and as such should replace the latter in the Standard Specification. It is evident that the dark red colonies appearing on the M-LES plates should not be ignored but should be subjected to confirmation of lactose fermentation on a medium such as M-LAC broth. Also, Aeromonas hydrophila appears as a dark red colony on M-LES, similar in appearance to the coliforms which have not developed sheen. It thus interferes with coliform identification. It is suggested that an oxidase test be carried out at the same time as the suspect colony is transferred to the lactose medium for the fermentation test to eliminate Aeromonas and other oxidase positive organisms. M-LES plates for best performance should be poured under daylight conditions and dried in an incubator at 31 degrees C. The plates should not be used immediately on preparation but between 48 hr and 5 days after pouring. The total coliform test has value as an indicator of the adequacy of water treatment processes, but the detection of E. coli 1 is the only real indication of fecal contamination. (Baker-FRC)
W83-03762

ISOLATION, IDENTIFICATION, AND DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN SEWAGE,
Akademia Medyczna, Gdansk (Poland). Dept. of Physical Chemistry.
J. Grzybowski, A. Radecki, and G. Rewkowska.
Environmental Science and Technology, Vol 17, No 1, p 44-47, January, 1983. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Wastewater analysis, *Aromatic hydrocarbons, *Organic compounds, *Pollutant identification, Polynuclear aromatic hydrocarbons, Chromatography, Liquid chromatography.

Fifteen polycyclic aromatic hydrocarbons (PAH) were simultaneously determined in sewage effluents, using high pressure liquid chromatography with ultraviolet detection at 254 nm. A standard solution of benzo(a)pyrene and benzo(b)chrysene was used as an internal standard to eliminate estimation of recovery after each run and the use of calibration curves for particular hydrocarbons. The column was packed with Zorbax ODS. The column temperature was 30C, and methanol-water (80:20) was used as the mobile phase. In the sewage effluents tested, the highest concentration of any single PAH was 14-52 ppb of benzo(j)fluoranthene. Other PAH included fluorene, phenanthrene, anthracene, fluoranthene, pyrene, chrysene, benz(a)anthracene, benzofluoranthenes, benzopyrenes, perylene, dibenzanthracenes, and benzo(ghi)perylene. PAH were detected to a lower limit of 0.1 ppb. (Cassar-FRC)
W83-03794

ENVIRONMENTAL QUALITY STANDARDS--NEW PROBLEMS FOR THE ANALYST,
G. A. Best.
Effluent and Water Treatment Journal, Vol 22, No 11, p 416-418, 420, November, 1982. 5 Tab, 6 Ref.

Descriptors: *Water quality standards, *Environmental quality, *Monitoring, Pollutant identification, Effluent standards, Standards, Fish, Toxicity, Fate of pollutants, Metals, Heavy metals, *Europe.

The EEC (European Community) has adopted the 'environmental quality objectives' (EQO) approach to emission standards in place of the previously used fixed emission standard. Although the EQO is a more realistic approach, it requires additional information such as behavior of a pollutant when it enters a river, its toxicity and interaction with other substances, and the intended use of the receiving water. Toxicity literature is far from adequate, and much data cannot be reliably extrapolated from the laboratory to natural sites. After the EQO and appropriate limits for consent conditions have been established, a monitoring program must be devised. With an EQO approach monitoring must be intensive, covering both effluent and receiving water. Analytical methods must be capable of detecting very low concentrations of pollutants, optimally 1/10 of the environmental quality standards. To minimize purchase of expensive and sensitive analytical equipment, some authorities monitor the major discharges for both pollutants and volume and calculate the concentrations of pollutants in the receiving waters from river flow data. However, there are statistical problems with this approach. (Cassar-FRC)
W83-03798

2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN SEDIMENT SAMPLES FROM LOVE CANAL STORM SEWERS AND CREEKS,
New York State Dept. of Health, Albany.
R. M. Smith, P. W. O'Keefe, K. M. Aldous, D. R. Hilker, and J. E. O'Brien.
Environmental Science and Technology, Vol 17, No 1, p 6-10, January, 1983. 5 Fig, 3 Tab, 18 Ref.

Descriptors: *Chemical wastes, *Organic compounds, *Landfills, Industrial wastes, Fate of pollutants, *Dioxin, Love Canal, Niagara Falls, *New York, Waste dumps, Sediments, Leachates.

Concentrations of 2,3,7,8-tetrachlorodibenzo-p-dioxin in storm sewers and creek sediments in the Love Canal section of Niagara Falls, New York, ranged from 0.9 to 312 ng per g in samples collected at six sites during 1979-80. This highly toxic, stable, water-insoluble isomer is not found in nature. Use of high performance liquid chromatography (Zorbax ODS followed by partially deactivated Zorbax Sil), capillary gas chromatography (OV-17/Poly S-179), and high resolution mass spectrometry distinguished the 2,3,7,8 isomer from the other 21 tetrachlorodibenzodioxin isomers and 75 closely related polychlorinated dibenzodioxins. The highest concentration of the dioxin isomer was found immediately adjacent to the canal at its southern end. The source of the dioxins is a heavy, chlorinated oily residue in the former chemical waste dump. (Cassar-FRC)
W83-03814

INDICES FOR WATER QUALITY ASSESSMENT IN RIVERS: A CASE STUDY OF THE LINGGI RIVER IN MALAYSIA,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
B. N. Lohani, and N. Mustapha.
Water Supply and Management, Vol 6, No 6, p 545-555, 1982. 8 Fig, 8 Tab, 3 Ref.

Descriptors: *Water quality control, *Developing countries, *Water quality indices, Rivers, Linggi river, *Malaysia, Data gathering, Multivariate factor analysis, Pollutant identification.

Opinion survey and factor analysis water quality indices (OP and FA WQI) were developed for assessing water quality in the Linggi river in Malaysia. Considering that the ratings and weightings for the OP and FA WQIs were derived by two different and exclusive ways, one by popular opinion and one purely by the use of a computer, it is interesting to note the similarity in their profiles as testified by the graphical results presented. The difference between them arises in the vastly fluctuating property of the FA index at locations of extremely good or extremely poor quality water. Thus the FA index is more sensitive. Further, it has the distinct quality of clustering important variables, thus indicating the type of pollution affecting each reach. In its similarity to the computer based FA index, the OP index may corroborate to a certain extent the somewhat underestimated capability of local water resources personnel to ascertain river water quality. In addition, continued use of the OP index may be beneficial in the long run, to assess the changes over time in human perception regarding water quality. However, it is suspected that, given the computing facilities, the FA index would be preferable for a system with a large inventory of monitoring data. (Baker-FRC)
W83-03844

5B. Sources Of Pollution

EVOLUTION OF NITRATE CONCENTRATIONS IN GROUNDWATER IN THE MIDDLE VAUD REGION (SWITZERLAND) (EVOLUTION DES CONCENTRATIONS EN NITRATES DES EAUX SOUTERRAINES DU MOYEN-PAYS VAUDOIS),
Inspectorat Cantonnal des Eaux, Lausanne (Switzerland).
E. Bosset.
Techniques et Sciences Municipales, Vol 1, p 19-28, January, 1981. 9 Fig, 24 Ref. English summary.

Descriptors: *Groundwater contamination, *Nitrates, *Switzerland, Groundwater, Drinking water sources, Orbe Valley, Venoge Valley, Molasse Plateau, Water table, Fate of pollutants, Organic compounds.

The nitrate concentration in groundwater samples of the Middle Vaud Region, and notably of the Molasse Plateau between the Lakes of Neuchatel and Morat, the Baud-Freiburg frontier, the southern border of the vast Forest of Jorat, and finally the eastern slopes of the Venoge and Orbe Valleys has gradually increased, except in the forest-clad zones protected from important foreign interferences. These data were gathered over the past 20 years. These increases are of particular interest in the Lower Broye, the part of the Plateau between the valleys of Orbe and Broye, as well as in the eastern slope of the Venoge Valley, as these zones contain high proportions of permeable soils. In several parts of the region nitrate concentrations now exceed the standard of 40 mg N03/liter prescribed by the Swiss Manual for Food Products. A precarious situation has thus been created, which requires that the applications of nitrate fertilizers on fields and meadows be drastically restricted. Control of agricultural applications is thus of chief importance. The task of the Swiss federal offices concerned is to give priority to the protection of the groundwater which is or may be use for consumption, even at the price of a decrease in agricultural output. (Baker-FRC)
W83-03508

WATER POLLUTION DUE TO INDUSTRIAL TROUT PRODUCTION IN FISH FARMS (GEWASSERBELASTUNG DURCH INDUSTRIEMASSIGE FORELLENPRODUKTION IN RINNENANLAGEN),
Wasserwirtschaftsdirektion Oder Havel, Potsdam (German D.R.).
A. Britz, and H-D. Muller.
Wasserwirtschaft-Wassertechnik, Vol 32, No 7, p 230-232, July, 1982. 7 Tab, 11 Ref. (No English Summary).

Descriptors: *Fish farms, *Trout, *Nitrogen, *Phosphorus, *Biological oxygen demand, Oxygen demand, Water quality, Water pollution, Nitrates, Nitrogen compounds, Orthophosphates, Seasonal variation, *German Democratic Republic, Population equivalents.

Water pollution studies were conducted at two East German trout farms: in May, July, and October 1975 at the Zippelsforde breeding facility (Z), where trout are fattened from about 10 g each to 40-70 g; and in June, August, and November 1976 at the Obere Plane farm (OP), where the fattened fish are brought up to their harvesting weight of about 250 g. Fish activity and food vary according to the fish's age and weight. Five-day BOD was 4,792-5,966 g/ton fish per day at Z, for an annual mean of 5,468 g/ton fish per day. The corresponding figures at OP were 3,390-4,697 and 4,047 g/ton fish per day (75 PE). At Z, nitrogen in the form of NH4-N was found at the level of 450 g/ton fish per day, with mean increases of 0.04 mg/1 on May 8-10, 0.09 mg/1 on May 17-18, and 0.21 mg/1 on October 16-17. The increases were attributed to increases and changes in food given in the course of the year and to seasonal variation in flow volume and water temperature. NO3-N annual mean concentration was 47 g/ton fish per day. Orthophosphate loads were an average of 235 and 390 g/ton fish per day at Z and OP, respectively. Corresponding figures for total phosphorus were 529 and 857 per year. The five-day BOD produced at Z correspond to that produced by 102 population equivalents (PE), that at OP to 75 PE. Corresponding values for nitrogen and phosphorus were 110 and 86 PE at Z and 109 and 140 PE at OP. (Gish-FRC)
W83-03520

BIOLOGICAL PROBLEMS IN COOLING WATER CIRCULATION (BIOLOGISCHE PROBLEME IM KUHLWASSERKREISLAUF),
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
A. Sladeckova.
Wasserwirtschaft-Wassertechnik, Vol 32, No 8, p 271-273, August, 1982. 1 Fig. (No English Summary).

Descriptors: *Cooling water, *Microoganisms, *Water pollution sources, *Water pollution prevention, *Water pollution control, Cooling towers, *Czechoslovakia, Raw water, Biocides, Bacteria, Iron bacteria, Sulfur bacteria, Zoogloea, Sphaerotilus natans, Algae, Larvae, Protozoa, Environmental control, Water quality control, Aerosols, Sedimentation, Water treatment.

Undesirable micro- and macroorganisms that populate cooling facilities in Czechoslovakia are described, and methods of preventing and solving this problem are discussed. Organisms in cooling water originate in three sources: raw water obtained from treated or untreated surface water or air, and secondary multiplication of organisms from the first two sources. Colonizing organisms include Sphaerotilus natans, which is carried in with organically polluted water; sulfur bacteria, which indicate microaerobic conditions as well as the presence of sulfur (these conditions often lead to corrosion); iron bacteria, entering the system with water with an excessive divalent iron content and multiplying where corrosion exists; Zoogloea ramigera, indicating heavy organic pollution; mycophytes; algae, which occur in open facilities; protozoa and invertebrates that occur in already existing colonies; chironomid and other larvae; and the snail Physa and the mussel Dreissena, which stem from stagnant and brackish river water, respectively. All agents added to reduce corrosion and sedimentation should be tested for their biological effects. (Gish-FRC)
W83-03528

ORGANICALLY-BOUND COPPER IN LAKE AND RIVER WATERS IN JAPAN,
Environmental Pollution Research Center, Ibaraki Prefecture, Mito (Japan).
M. Negishi, and K. Matsunaga.
Water Research, Vol 17, No 1, p 91-95, January, 1983. 5 Fig, 3 Tab, 35 Ref.

Descriptors: *Copper, *Rivers, *Lakes, Heavy metals, Natural waters, Organic compounds, *Japan, Hokkaido, Fulvic acid, Humic acids.

The organically-bound copper, organic matter and the apparent molecular weight of the organic matter in lake and river waters were measured; the interaction between copper and the organic matter was also investigated at Hokkaido, Japan. The concentrations of reactive, Cu in surface water of Lake Ohnuma and the Shurunohe river ranged from 0.42 to 1.16 micrograms/liter, with an average of 0.73 micrograms/liter. The average concentration of organic copper was 0.33 micrograms/liter. Average total dissolved copper and reactive copper levels in the other lakes and rivers studied were 1.20 and 1.16 micrograms/liter, respectively. The average organic copper/total copper ration in Lake Ohnuma and the Shukunohe river was larger that those in the other lakes and river waters. The concentration of fulvic acid in all lake and river waters was 1.6 to 7.1 mg/liter, with an average of 4.1 mg/liter. The main quantity of organic matter contained in the lake water had a low molecular weight of 300-700 and was assumed to be fulvic acid originating in the river. (Baker-FRC)
W83-03536

SURVEY OF TRIHALOMETHANE LEVELS IN RHONE-ALPS WATER SUPPLIES. ESTIMATES ON THE FORMATION OF CHLOROFORM IN WASTEWATER TREATMENT PLANTS AND SWIMMING POOLS,
Institut Pasteur de Lyon (France). Lab. de Toxicologie.
P. Chambon, M. Taveau, M. Morin, R. Chambon, and J. Vial.
Water Research, Vol 17, No 1, p 65-69, January, 1983.

Descriptors: *Trihalomethanes, *Water analysis, Swimming pools, Drinking water, Surface waters, Haloforms, Organic compounds, Water pollution sources, Rhone, Alps, *France.

A survey was undertaken in the Rhone-Alps region of haloforms in various types of water samples. Drinking water samples were shown to contain very low levels of haloforms. Surface water and water at the outlet of wastewater treatment plants had significantly higher haloform levels, both around 6 times more than drinking water samples. As for swimming pools, where high levels of haloforms were found, there is a possibility that some metabolites of human origin such as citric acid and dihydroxybenzoic acid might serve as precursors. One positive argument of this theory is the fact that concentrations of haloforms found in covered swimming pools in the summer were very much higher than in winter, probably due to the large number of people bathing in the summer. (Baker-FRC)
W83-03540

OXIDATION OF FERROUS IRON BY ACIDOPHILIC IRON-OXIDIZING BACTERIA FROM A STREAM RECEIVING ACID MINE DRAINAGE,
Tohoku Univ., Sendai (Japan). Dept. of Civil Engineering.
T. Noike, K. Nakamura, and J. Matsumoto.
Water Research, Vol 17, No 1, p 21-27, January, 1983. 12 Fig, 6 Tab, 5 Ref.

Descriptors: *Iron compounds, *Bacteria, *Acid mine drainage, Fate of pollutants, Mine drainage, Aka River, *Japan, Oxidation, Iron bacteria.

The oxidation of ferrous iron by acidophilic iron-oxidizing bacteria was affected by pH, water temperature, and glucose concentration. Experiments were conducted in the field at the abandoned Matsuo sulfur and iron sulfide mine, discharging into the Aka River, Japan, and in laboratory batch and continuous experiments. Greatest activity was noted at 30 C and pH 2. The percentage oxidation of ferrous iron increased with time of river flow from the source and increased exponentially with increases in water temperature from 20 to 30 C. The iron bacteria accelerated the rate of pyrite oxidation. The number of bacteria attached to the surface of a rotating biological disk increased as the loading of ferrous iron increased from 40 to 240 g per sq m per day. (Cassar-FRC)
W83-03541

PHYSICO-CHEMICAL SPECIATION OF SELECTED METALS IN THE TREATED EFFLUENT OF A LEAD-ACID BATTERY MANUFACTURER AND IN THE RECEIVING RIVER,
D. P. H. Laxen, and R. M. Harrison.
Water Research, Vol 17, No 1, p 71-80, January 1983. 3 Fig, 10 Tab, 35 Ref.

Descriptors: *Speciation, *Industrial wastes, *Outfall, Receiving waters, Lead, Cadmium, Copper, Iron, Manganese, Heavy metals, Water pollution effects.

A scheme for the speciation of metals in freshwaters has been applied to the metals Pb, Cd, Cu, Fe, and Mn in the treated effluent of a lead-acid battery manufacturer and the receiving river upstream and downstream of the effluent outfall. The principal operations on the 15 ha site of the plant are secondary smelting of lead and fabrication of lead-acid batteries. Liquid effluent contaminated mainly with lead and sulfuric acid arise principally during lead recovery from scrap batteries, as well as during paste production and plate forming. River samples were taken within 10 min of each other during the early stages of a storm when river flow was considerably above its normal level. Comparison of samples immediately upstream and downstream of the Chloride Company outfall shows evidence of a slight dilution of some ions in the downstream sample. The increase in the total lead concentration of 10 micrograms/liter is evidence of the influx of this metal from the effluent treatment plant. Lead appears to behave differently from cadmium and copper, with the implication that if the latter are associated with humic acids then lead is probably not. The final results indicate that only in the case of lead does the effluent

discharge create a significant effect upon metal concentrations in the river. (Baker-FRC)
W83-03544

ORGANIC MICROPOLLUTANTS IN EFFLUENT RECHARGE TO GROUNDWATER,
Water Research Centre, Marlow (England).
L. Clark, and K. M. Baxter.
Water Science and Technology, Vol 14, No 12, p 15-30, 1982. 13 Fig, 5 Tab, 6 Ref.

Descriptors: *Micropollutants, *Groundwater, Water quality, Water pollution sources, *Effluent recharge, Organic compounds, Fate of pollutants, Chalk, Groundwater recharge, Infiltration, Aquifers, Water sampling, *Path cf pollutants, *England, Hampshire.

Groundwater pollution by organic material derived from the recharge of raw, untreated sewage effluent has been studied at the sewage treatment works at Whitchurch in Hampshire. This organic investigation consisted of two parts; the validation of the sampling and analytical techniques and the field investigation. Sampling points for the survey included open boreholes lined with uPVC or mild steel as well as specially designed buried in situ groundwater samplers of uPVC or stainless steel construction. Laboratory leaching tests show significant pollution of sampled water by nylon and uPVC components and indicate that all plastics must be avoided in sample point construction. The in situ samplers with stainless steel bodies and PTFE sampling tubes proved satisfactory. The organic field survey showed that the organic pollution plume is conincident with the inorganic plume from the effluent recharge site. The total content of the effluent is reduced through infiltration; 85% is removed in the unsaturated zone and a further 14% during 300 m of lateral flow. The number of organic compounds at significant concentrations is also greatly reduced through infiltration. The most persistent micropollutant identified as coming solely from the sewage is dichlorobenzene, which is present at about 9 micrograms/liter below the recharge lagoons and 1 microgram/liter in the pollution plume 300 m from the site. (Baker-FRC)
W83-03553

NATURE AND ORIGIN OF MICROPOLLUTANTS,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
D. Mackay.
Water Science and Technology, Vol 14, No 12, p 5-14, 1982. 6 Fig, 12 Ref.

Descriptors: *Water pollution sources, *Micropollutants, Water quality, Water quality control, Toxicity, Water treatment, Risk assessment, Public health, Water pollution effects.

The origins of micropollutants are discussed and classified. It is suggested that assessing the risk and ensuring an acceptably low level of adverse effects from these substances requires information on or control of three factors: exposure, toxicity and characteristics of the victim or organism, which combine to generate the toxic event. Methods of estimating exposure are discussed, especially environmental models. Ultimately, it should be possible to couple these models to toxicity data in a rational, rigorous manner to elucidate the extent of risk and control it to an acceptable level. It is futile to expect that the solution to this problem lies in any one discipline or activity such as water treatment technology, environmental exposure analysis, toxicology in the sense of biological effects of toxicants on organisms or risk assessment, and public education or indoctrination. Only by a combined balanced inter-disciplinary effort can real progress be made on all fronts to achieve an optimal reduction in real and perceived public hazard. (Baker-FRC)
W83-03555

LAND APPLICATION OF SEWAGE SLUDGE LANDFILL LEACHATE,
Rhode Island Univ., Kingston. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 5E.
W83-03563

ATMOSPHERIC RELEASE OF CHLORINATED ORGANIC COMPOUNDS FROM THE ACTIVATED SLUDGE PROCESS,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
For primary bibliographic entry see Field 5D.
W83-03583

A METHOD TO COMPUTE RIVER HEATING - APPLICATION TO THE MANAGEMENT OF THERMAL LOADINGS TO THE RHINE RIVER (UNE METHODE DE CALCUL DE L'ECHAUFFEMENT DES RIVIERES - APPLICATION A LA GESTION DES REJETS THEMIQUES AU RHIN),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 5G.
W83-03584

THE FRESHWATER ASIAN CLAM (CORBICULA FLUMINEA) AS A FACTOR AFFECTING NUTRIENT CYCLING IN THE CHOWAN RIVER, N.C.,
North Carolina State Univ. at Raleigh. Dept. of Zoology.
D. D. Lauritsen, and S. C. Mozley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235226, Price codes: A04 in paper coopy, A01 in microfiche. Water Resources Research Institute Report No 192, North Carolina State Univ., Raleigh, May 1983. 70 p, 14 Fig, 4 Tab, 54 Ref, 3 Append. OWRT A-124-NC(1), 14-34-0001-2135.

Descriptors: *Cycling nutrients, *Orthophosphates, *Ammonia, Phosphorus compounds, Nitrogen compounds, *Clams, Benthic fauna, Excretion, Feeding rates, Algae, Cyanophyta, Anabaena, Chlorophyta, Chlorella, Scenedesmus, *Chowan River, *North Carolina.

The Asian clam (Corbicula Fluminea) has recently invaded the Chowan River and reached stable population densities(200/m2) in the northern part of the river and major tributaries. Benthic organisms such as Corbicula can affect nutrient cycling in the river by such means as burrowing, sediment reworking, and excretion. This study was conducted to evaluate the importance of the clam as a source of recycled nutrients which can contribute to the growth of nuisance blue-green algae, and to determine whether Corbicula is able to utilize blue-green algae as a food source. This work determined that, unlike many organisms, Corbicula assimilated blue-green algae(Anabaena) more efficiently than it did green algae(Chlorella and Scenedesmus). It also determined that Corbicula is able to rapidly recycle nutrients (NH4 and P04), important for algal growth. In parts of the river where the clam is abundant, excretion rates are significantly higher than sediment flux rates of the same nutrients. The clam can make a significant contribution to nutrient cycling, thus, any attempts to model nutrient cycling in the river must take Corbicula abundance into account.
W83-03588

SOURCES AND FATES OF SEDIMENTARY ORGANIC MATTER IN THE WHITE OAK AND NEUSE RIVER ESTUARIES,
North Carolina Univ. at Chapel Hill. Dept. of Geology.
L. K. Benninger, and C. S. Martens.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235242, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 194, North Carolina State Univ., Raleigh, May 1983. 72 p, 13 Fig, 3 Tab, 41 Ref. OWRT A-128-NC(1), 14-34-0001-2135.

Descriptors: *Organic matter, *Sediments, *Radioactive dating, Microbial degradation, Rivers, Estuaries, Carbon radioisotopes, Lead radioisotopes, *North Carolina, Neuse River, White Oak River.

As a substrate for microbial growth, organic matter in the sediments of rivers and estuaries represents a potential oxygen demand on, and nutrient source to, the overlying water. The actual impact of sedimentary organic matter on water quality depends upon the rate of microbial degradation, which is strongly influenced by the source(hence the composition) of the organic matter. The question of the sources and fates of organic matter in coastal sediments is addressed through the combined use of modern sediment chronology and carbon isotopic analysis (super 12C, super 13C, super 14C) of sedimentary organic matter. Sediment cores from one upriver, and one downriver location in the small, sparsely populated White Oak River estuary and the larger, more populous Neuse River estuary were studied in detail. Stable carbon isotopes in organic matter were generally heavier in downriver(relative to upriver) sediments, consistent with increased inputs of marine organic matter at downriver locations. Analysis indicated organic matter inputs include both recently produced and aged material. Because newly produced organic material is more susceptible to microbial degradation, it was expected that organic matter supplied to the river-estuary from aged reservoirs(soil, sediments, etc.) would be preferentially preserved relative to recently produced organic matter. However, the issue of preferential preservation is unresolved due to non-steady-state in super 14C concentration of organic-matter inputs.
W83-03590

THE FATE, DISTRIBUTION AND LIMNOLOGICAL EFFECTS OF VOLCANIC TEPHRA IN THE ST. JOE AND COEUR D'ALENE RIVER DELTAS OF LAKE COEUR D'ALENE, IDAHO,
Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
J. M. Skille, C. M. Falter, W. R. Kendra, and K. M. Schuchard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235309, Price codes: A08 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Moscow, June 1983. 156 p, 28 Fig, 28 Tab, 12 Ref. OWRT C-10103-V(No 1460)(1).

Descriptors: *Bottom sediments, *Lake sediments, *Volcanoes, *Limnology, Heavy metals, Upwelling, Biological properties, Chemical properties, Physical properties, Water chemistry, Particle size, Plankton, Benthos, *Idaho, Mt. St. Helens, Volcanic ash, Lake Coeur d'Alene, St. Joe River, Coeur d'Alene River.

The purpose of this research was to determine the effects of the tephra (volcanic ash) fallout from the May 18, 1980 eruption of Mt. St. Helens on a lake-river system 200-300 miles east of the volcano. Lake Coeur d'Alene in northern Idaho was chosen for the study as a water system which would reflect the more subtle impacts of ash fallout in contrast to the immediate and devastating impact to lakes and streams near the volcano. The specific objectives were to quantify and identify volcanic ash in the lake sediments and water columns, describe chemical conditions in the sediments and water columns, and to assess the effects of volcanic tephra on the benthic, phytoplankton, and zooplankton communities. The ash layer was relatively uniform in thickness throughout the lake and delta sediments. Sediments deposited over the initial ash layer contained only small quantities of ash. The ash layer in the lake sediments and throughout the watershed was stable and not easily resuspended or eroded. The volcanic tephra was chemically inert and had no measurable impact on water chemistry or nutrient enrichment. Benthic and planktonic communities were unchanged relative to pre-ash conditions.
W83-03597

STUDIES IN DYE-TRACING TECHNIQUES AND KARST HYDROGEOLOGY,

Kentucky Water Resources Research Inst., Lexington.
J. Thrailkill, P. E. Byrd, S. B. Sullivan, L. E. Spangler, and C. J. Taylor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235312, Price codes: A05 in paper copy, A01 in microfiche. Research Report No 140, July 1983. 97 p, 36 Fig, 13 Tab, 43 Ref. OWRT B-064-KY(2), 14-34-0001-9115.

Descriptors: *Dyes, *Karst hydrology, Groundwater movement, Groundwater pollution, Karst, Limestone, Aquifers, Inner Bluegrass Karst Region, *Kentucky.

Information on fluorescent dyes used for water tracing and the results of six studies are reported. Optical brightener, direct yellow, fluorscein, rhodamine (WT), and other dyes are described and the producers employed in their use in the field and in equilibration experiments are described. Three of the six studies consisted of investigations of the equilibration with passive detectors of three of the dyes. The absorption of optical brightener on fabric detectors was apparently linear with concentration and with immersion time, while detectors became rapidly saturated with direct yellow. Equilibrium of fluorescein on charcoal detectors with an elutriating solution was not achieved. Several data processing tasks were performed, including the creation of a computer file for field data and the writing of programs to sort the field data and generate plotted maps, and to display the total fluorescence of samples. A fifth study was based on a series of dye traces into Royal Spring and Russell Cave Spring in the Inner Bluegrass Karst Region. Samples were collected with an automatic water sampler and the resulting flow velocity determinations combined with discharge data provided values at a number of aquifer parameters. The most interesting results was the very small value for depth of flow. Fracture traces were identified on topographic maps and aerial photographs in the Inner Bluegrass Karst Region.
W83-03599

IMPACT OF ARTIFICIAL RECHARGE ON GROUNDWATER QUALITY OF GYPSUM AQUIFER IN HARMON COUNTY, OKLAHOMA,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
A. K. Tyagi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235499, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Stillwater, Okla., 40 p, 3 Fig, 3 Ref, 1 Append. OWRT A-107-OKLA(1), 14-34-0001-1138.

Descriptors: Storage coefficient, *Transmissivity, *Strongly Implicit Procedure, Method of Characteristics, *Dispersion coefficient, Groundwater pollution, Groundwater basin, Gypsum aquifer, Groundwater velocity, Water quality, *Oklahoma, *Artificial recharge, Model studies.

The strongly Implicit Procedure (SIP) is used to solve the groundwater flow equation, replacing the Alternating Direction Implicit Procedure (ADIP) in the solute transport model (1978, 1979), developed by the U.S. Geological Survey. The SIP Model was then coupled with the dispersion equation solved by the Method of Characteristics (MOC). The comparisons of the SIP-MOC Model against the ADIP-MOC Model indicate that the convergence rate in the flow portion of the problem is significantly improved, saving computer time ad the user's computer cost. The SIP Model handles problems which cannot be conveniently solved by the ADIP Model.
W83-03607

THE IMPACT OF URBANIZATION ON A FLOOD-PLAIN AQUIFER: BLOOMINGTON, INDIANA,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
M. G. Filippini, and N. C. Krothe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235515, Price codes: A06 in paper copy, A01 in microfiche. Technical Report No 156, March 1983. 103 p, 32 Fig, 6 Tab, 25 Ref, 5 Append. OWRT A-062-IND(1).

Descriptors: *Groundwater pollution, *Fate of pollutants, *Groundwater-surface relations, *Urban runoff, Urban watersheds, Polychlorinated biphenyls, Isotopic tracers, Bloomington, *Indiana.

The flood-plain adjacent to Clear Creek in Bloomington, Indiana was the setting for a study of the impact of urbanization on the local ground waters. Organic and inorganic water quality data were obtained from ground water below and adjacent to Clear Creek. The increased runoff and chemical pollution due to urbanization had marked effects on stream and beneath stream waters but little effect on shallow flood-plain ground waters bordering the drainage catchment. Beneath-stream groundwaters contained significantly higher concentrations of chloride, sodium and potassium than flood plain groundwaters. EPA priority pollutants were not found anywhere in the ground water system; however, PCB's were detected in the surface waters. PCB's are thus filtered out of the water by the sediment column. An oxygen isotope analysis showed that before a storm the creek is effluent with respect to flood-plain ground waters. As stage increases the steam becomes influent, returning to effluent conditions after the storm water has receded in the stream.
W83-03609

A PRELIMINARY INVESTIGATION INTO THE USE OF CRAYFISH AS A SENSITIVE SPECIES TO POLLUTANTS IN THE CLARK FORK RIVER NEAR MISSOULA, MT,
Montana Univ., Missoula. Dept. of Botany.
C. C. Gordon, and A. J. Silverman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-236117, Price codes: A03 in paper copy, A01 in microfiche. Montana Water Resources Research Report No 133, Univ. of Montana, Bozeman, June 1983. 27 p, 83 Ref. OWRT A-083-MONT(1), 14-34-0001-1128.

Descriptors: *Industrial wastes, Crayfish, Water quality, Sampling instrumentation, *Heavy metals, Sampling, Pulp waste, *Water quality, Indicators, Sensitivity, Atomic absorption, Spectra, Environmental indicators, Clark Fork River, Missoula, *Montana.

Crayfish appear to be, at least theoretically, a good indicator of water quality associated with point source pollution. An attempt to evaluate the sensitivity of crayfish to heavy metal contamination associated with the Hoerner-Waldorf (Champion International) pulp and paper mill along 30 miles of the Clark Fork and Bitterroot Rivers near Missoula, Montana, was initiated in the fall of 1977. The design for trapping and analyzing the crayfish was based upon extensive literature review and study. The analytical procedures used were standard for evaluation of heavy metals in soft tissue by atomic absorption spectra. Results of the preliminary study showed variation in concentration as a function of the animal part analyzed. Changes in concentration as a function of proximity to the pulp mill was not demonstrated; both sample number and sites were probably inadequate to show any relation to a point source, if one existed. It is concluded that crayfish chemical variation may be an important environmental indicator of pollution provided a statistically and ecologically valid sampling program were instituted to test the system.
W83-03617

MOVEMENT OF SALT AND HAZARDOUS CONTAMINANTS IN GROUNDWATER SYSTEMS,
Florida Univ., Gainesville. Dept. of Civil Engineering.
B. A. Benedict, H. Rubin, and S. A. Means.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-236125, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 71, Florida Univ., Gainesville, May 1983. 126 p, 49 Fig, 4 Tab, 29 Ref, 2 Append. OWRT A-047-FLA(1), 14-34-0001-2110.

Descriptors: *Groundwater, *Water pollution sources, *Dispersion, Injection wells, Aquifers, *Path of pollutants, Model studies, *Florida, Solute transport, Stratified flow, *Saline water intrusion, Saline-freshwater interfaces.

A method has been developed to significantly reduce computer resources required to model groundwater contaminant movements. The method has been tested by applying it to the stratified flow problem of upward seepage of saltwater into freshwater aquifers overlying semiconfining formations, such as occurs in northeastern Florida. The basic equations of continuity, motion, and solute transport are solved simultaneously after being simplified by the Dupuit assumption and a boundary layer approximation. These are applied to a flow field divided into a freshwater zone, saltwater zone, and transition zone. The equations are cast in a finite difference model. Results of executing the model indicate that it is highly stable and convergent. The model is capable of describing the three-dimensional flow field and salt distribution in a transient stratified flow in an aquifer. While the specific example treated salt movement, other contaminants, including hazardous wastes could easily be modeled in the same way in a stratified flow. In addition, if the contaminant did not bring about stratified conditions or occur in a saline-stratified region, the same basic procedure can be utilized by removing contaminant influence on the flow field in the equation of motion.
W83-03619

IMPACT OF SNOWMELT-RUNOFF FROM AGRICULTURAL WATERSHEDS ON DISSOLVED OXYGEN,
Wisconsin Dept. of Natural Resources, Rhinelander.
J. F. Sullivan.
Journal of the Water Pollution Control Federation, Vol 55, No 2, p 170-177, February, 1983. 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Snowmelt, *Agricultural runoff, *Nonpoint pollution sources, Fish kills, Agricultural wastes, Animal wastes, Dairy industry, *Dissolved oxygen, Upper Wisconsin River, Agricultural watersheds, Runoff, Watersheds, Water pollution sources, Fate of pollutants, *Wisconsin.

Dissolved oxygen levels dropped to as low as 2 mg per liter in some sections of the Upper Wisconsin River on March 28, 1980, shortly after the season's first major runoff event. Fish kills occurred in the Big Eau Pleine Reservoir. An investigation of water quality in tributaries and at pulp and paper plants revealed that the source of pollution was agricultural wastes such as animal and cheese wastes applied to fields. This nonpoint pollution source was not recognized previously for several reasons. An extensive automatic monitoring system has been installed. Excessive paper mill discharges, which have been reduced by pollution control, formerly masked the impact of agricultural wastes. Below normal snowfall and long periods of bare frozen soil that winter facilitated spreading of manure and cheese wastes. Nonpoint source pollution control should be implemented in problem watersheds. (Cassar-FRC)
W83-03636

A FINITE ELEMENT MODEL TO PREDICT THE FLOW OF UNDERGROUND CONTAMINANTS DUE TO LEAKAGE OF CHEMICAL AND/OR RADIOACTIVE MATERIAL FROM A BURIED CONTAINMENT,
Clemson Univ., SC. Dept. of Civil Engineering.
S. C. Anand, and A. Pandit.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243113, Price codes: A13 in paper copy, A01 in microfiche. Water Resources Research Institute Publication No 107, Clemson Univ., S.C., June 1983. 258 p, 76

Fig, 28 Tab, 39 Ref, 13 Append. OWRT A-051-SC(1), 14-34-0001-2143, 1143.

Descriptors: *Confined aquifers, *Saturated flow, Pollutants, *Mathematical models, *Finite element method, Computer models, Numerical analysis, *Path of pollutants, Saline water intrusion, Wastewater pollution, Laminar flow, Model studies, Mass transfer, Porous media.

In this investigation, a Galerkin finite element model in two dimensions is developed to study the phenomena of mass transfer in porous media. In particular, the problems of the saltwater encroachment in coastal aquifers and the transport of hazardous wastes in groundwater environment are studied for a wide range of aquifer parameters. The coupled governing partial differential equations are nondimensionalized and solved for a two-dimensional, saturated aquifer in the vertical plane for both steady state and transient conditions using an iterative solution procedure. The flow transport is represented either in terms of the stream function or the freshwater hydraulic head. It is found that the selection of an appropriate mesh, region, and time step size is quite important to obtain correct solutions in the saltwater intrusion problem. It is shown that the saltwater intrusion is primarily a function of the ratio of the aquifer depth to the longitudinal dispersivity of the medium, and the gradient of the piezometric surface. Contaminant transport episodes are simulated for anisotropic conditions which indicate that for certain extreme values of the nondimensional parameters, nodal concentration values near the source oscillate with time. Furthermore, episodes simulated including adsorption effects, indicated that the size of the polluted region is a direct function of the retardation factor, R sub d.
W83-03672

SOLUBILIZATION RATE OF ATMOSPHERIC PARTICULATE MATTER AND IMPACT ON WATER QUALITY,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
A. W. Elzerman, and T. J. Overcamp.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243162, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Publication No 104, Clemson Univ., S. C., December 1982. 93 p, 22 Fig, 15 Tab, 111 Ref, 2 Append. OWRT A-049-SC(1), 14-34-001-0143, 9043, 1143.

Descriptors: *Air pollution effects, Aquatic environment, *Chemistry of precipitation, *Fate of pollutants, *Particulate matter, *Solubility, Acid rain, Air-water interface, Ammonium, Atmospheric water, Cadmium, Calcium, Iron, Kinetics, Leaching, Lead, Magnesium, Nitrates, Organic carbon, Phosphates, Potassium, Precipitation scavenging, Sodium, Sulfate, Trace metals, Solubilization, Aerosol solubility, South Carolina.

Although total atmospheric concentrations and wet and dry fallout mass loadings of numerous materials have been measured, understanding the ultimate fate of aerosols in aqueous systems requires knowledge of their post-deposition interactions. The major objective of this investigation was to determine the extent and rate of solubilization of aerosols. Samples collected on Nuclepore filters were extraced with various solutions in a pump-flow apparatus and the eluant analyzed in fractions. In Clemson, S. C., area samples tested, 30 to 60% of the total mass was soluble. Major soluble components (sulfate, ammonium, nitrate, calcium, hydrogen ion) and minor soluble components investigated magnesium, lead cadmium, manganese, phosphate, organic carbon) were released to solution quickly, more than half in 30 seconds and essentially all of the soluble fraction within 5 minutes. Extraction solution pH had little effect on most soluble components but increased the rate and extent of solubilization of lead. Lead oxide and lead nitrate behaved similarly to aerosols. The initial fate of soluble components of aerosols will be controlled by rapid dissolution.
W83-03677

FATE OF HERBICIDES IN GROUNDWATER AND SURFACE RUNOFF AND THEIR BIOTIC EFFECTS ON PRAIRIE POTHOLES,
North Dakota Univ., Grand Forks. Dept. of Biology.
L. E. Shubert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246371, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, North Dakota State Univ., Fargo, June 1983. 27 p, 4 Fig, 5 Tab, 66 Ref. A-074 NDAK(1), 14-34-0001-1136.

Descriptors: *Algae, *Aquatic plants, *Aquatic productivity, Artificial substrate, Habitats, *Periphyton, *Pothole, Primary productivity, Water quality, *North Dakota, Fox Lake, *Fate of pollutants, Water pollution effects, Saline lakes.

It has been well documented that prairie potholes comprise one of the best wetland habitats for waterfowl breeding on the continent. Since prairie potholes are closed ecosystems, they are important natural retention storage basins for spring and summer runoff from native grasslands and cultivated land. Thus potholes act as 'energy sinks' which reduce sediment and nutrient loading to streams and lakes. The purpose of this study was to determine periphyton productivity in Fox Lake, a prairie pothole, located in Ramsey County, 46 km west of Grand Forks, N.D. The chemical-physical characteristics of Fox Lake for 1981 demonstrated that it was alkaline, saline and moderately eutrophic. Submerged surface area for all three plant communities increased with time and correlated well with the seasonal pattern of aquatic plant production. Typha latifolia had the greatest production but not the highest submerged surface area. Phytoplankton showed an increase early and/or late in the season (diatom blooms), whereas the epiphytes on the rods were most abundant in the main part of the growing season (July - mid August). Grazing by zooplankton was particularly intense late in the season and was a major factor for a decrease in epiphyte biomass. The Potamogeton community epiphytes had the greatest photosynthetic activity, followed by the Typha and Scirpus communities. It was suggested that light was the most significant factor affecting productivity because the PAR light was highest at the Potamogeton site. Fox Lake is an excellent model for studying prairie potholes and periphyton production.
W83-03682

WATER QUALITY OF AIRPORT STORM RUNOFF, PHASE II,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
G. L. Dugan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246439, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 153, May 1983. 44 p, 6 Fig, 4 Tab, 14 Ref, 2 Append. OWRT A-086-HI(1), 14-34-0001-1113.

Descriptors: *Storm runoff, *Water supply, *Water quality standards, Water sampling, Pollutant identification, Nonpoint pollution source, Heavy metals, *Airports, Honolulu International Airport, General Lyman Field, Kahului Airport, Keahole Airport, Lihue Airport, *Hawaii.

The quality of natural and induced storm water runoff from several smaller public airports in Hawaii (air traffic volume of approximately 130 to over 350 airplanes/day) was compared to results from the previous Phase I study of the Honolulu International Airport that handles daily nearly 900 airplanes. The mean annual rainfall of these airports ranges from approximately 381 mm (15 in.) to nearly 3 251 mm (128 in.). Two basic storm quality monitoring schemes were incorporated: the wet season and the dry season. The wet-season monitoring involved collecting storm runoff samples from paved surfaces during and following rainfall events at a specific airport. The dry-season monitoring scheme consisted of enclosing a 0.25-m super 2 (2.69-ft super 2) area, applying deionized water, and then collecting the wash water, leached chemicals, and sediments by a hand bilge pump. As was the case for the storm runoff quality from the previous study of the Honolulu International Airport, the runoff from the smaller airports also contained mercury and turbidity that significantly exceeded the primary drinking water regulations, while concentrations of phenol and carbon chloroform extract definitely indicated that petroleum-derived products would be too high (expensive to remove) for consideration as an alternate drinking water supply. However, the water, if collected and stored, could serve as a source of subpotable water.
W83-03688

CURRENTS IN SOUTH SAN FRANCISCO BAY,
California Univ., Berkeley. Hydraulic Engineering Lab.
H. B. Fischer, and G. A. Lawrence.
California State Water Resources Control Board Publication No 83-2sp, January 1983. 327 p, 7 Fig, 6 Ref, 8 Append.

Descriptors: *Water currents, *Bays, *Tides, *Flow characteristics, *Hydrologic data collections, *Current meters, Tidal currents, Neap tides, Spring tides, Salinity, Water temperature, Water pollution effects, Synoptic analysis, Flow profiles, Flushing, *San Francisco Bay.

During 1978-81, the U.S. Geological Survey and the National Ocean Survey made intensive field measurements of currents, salinity, and temperature at 34 stations in San Francisco Bay. This report describes describes the currents in a way useful to pollution and ecologically related studies; hydrodynamic transport is one link in the chain of input, transformation, accumulation and effects of pollution. Three levels of processing and archiving data were used: level one data were averaged into 30-minute blocks, placed in standard form, and time sequence, progressive vector, and current rose plots were drawn; in level two, the data were averaged to create a typical 25-hour tidal cycle with an emphasis on preserving the length and direction of the tidal excursion using progressive vectors; in level three, plots were prepared that showed typical tidal cycle motions and current distributions in the bay. Characteristic cycles were obtained for neap, spring, and 14-day mean conditions. Inconsistent or known defective data were discarded. The results were mostly consistent with theoretical predictions. The flow is generally back and forth in the direction of the main axis of the bay, almost independent of crosssectional location. Tidal excursions range from about 6 km at shallow stations to 12-20 km in the deeper ones, and tidal-averaged distribution corresponded to the prevailing easterly wind. These data provide a base for further analyses of flushing mechanisms---how much new water is available to dilute pollutants and/or supply nutrients. Suggestions are given for further work to complete the transport modelling, i.e. gravitational overturn, variation of daily mean, and salinity-velocity correlations. (Atkins-Omniplan)
W83-03690

MOVEMENT OF BACTERIA THROUGH MACROPORES TO GROUND WATER,
Kentucky Water Resources Research Inst., Lexington.
M. Smith, G. W. Thomas, and R. E. White.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246546, Price codes: A03 in paper copy, A01 in microfiche. Research Report No 139, June 1983. 38 p, 11 Fig, 5 Tab, 18 Ref. OWRT A-088-KY(1), 14-34-0001-2119.

Descriptors: Soil filters, Soil columns, Soil water, Soil properties, *Soil bacteria, *E. coli, *Path of pollutants, Soil moisture, Soil type, Soil profiles.

Effects of soil type, flow rate, antecedent soil moisture and other factors on transport of E. coli through soils was measured on disturbed and intact columns 20 cm in diameter by 25 to 30 cm in depth. Added E. coli were distinguished from indigenous microbes using an antibiotic resistance marker. Transport of Cl super - and super 3 H sub

2 O was also measured. Up to 96% of the bacteria irrigated onto the surface of intact columns were recovered in the effluent. Soil structure appeared to be related to the extent of transport. Columns prepared from mixed, repacked soil were much more effective bacterial filters than the intact soils. As rate of water input increased, the fraction of E. coli recovered in the effluent increased. We concluded that flow through soil macropores, which by-passes the adsorptive or retentive capacities of the soil matrix is a common phenomenon. This conclusion was supported by the behavior of Cl super - and super 3 H sub 2 O. In waste disposal systems dependent on purification in the soil profile, this could significantly increase the probability of ground-water contamination by microbes. The effect of native soil structure (macropores) must be considered in the evaluation of these purification systems.
W83-03705

KINETICS OF PHOSPHORUS UPTAKE IN THE CHOWAN RIVER, NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
K. L. Stone.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246959, Price codes: A05 in paper copy, A01 in microfiche. M. S. Thesis, 1982. 96 p, 23 Fig, 10 Tab, 83 Ref. OWRT B-127-NC(11), 14-34-0001-0275.

Descriptors: *Phosphorus, *Kinetics, *Phytoplankton, *Cyanophyta, *Eutrophication, *Cycling Nutrients, Rivers Seston, Algae, Nuisance algae, Limiting nutrients, Nitrogen, Seasonal variation, Chlorophyll A, Radioactive tracers, Phosphorus radioisotopes, Turnover time, Particle size, Bacteria, Light intensity, Water temperature, Hydrogen ion Concentration, *North Carolina, Chowan River.

Gross biotic uptake rates of filterable reactive phosphorus by plankton were measured in surface waters of the Chowan River from May 1980 to October 1981. Uptake rates varied widely, ranging from 0 to 6.15 mu M . h super -1, and were greater in the warmer months in the middle and lower reaches of the river. Abiotic phosphate uptake rates and ranged from 0.001 to 0.63 mu M . h super -1. Rapid biotic uptake coincided with low filterable reactive phosphorus concentrations and high levels of chlorphyll-a. Size fractionation of the uptake indicated that most of the uptake occurred in particles with dimensions less than 8.0 mu M. Phosphorus uptake rates and turnover times were good indicators of the phosphorus nutritional status of phytoplankton in the Chowan River. The plankton were often phosphorus limited during the summer months in the middle and lower river. Phosphorus uptake kinetics were discussed in relation to the occurrence of surface blooms of bluegreen algae and the relative abundance of nitrogen and phosphorus. Implications of phosphorus uptake kinetics in selecting appropriate management practices were also presented.
W83-03711

NITROGEN FIXATION AND DENITRIFICATION IN THE PAMLICO RIVER, NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
G. S. Allgood.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246967, Price codes: A05 in paper copy, A01 in microfiche. M. S. Thesis, 1983. 97 p, 9 Fig, 15 Tab, 67 Ref. OWRT B-144-NC(1), 14-34-0001-1257.

Descriptors: *Nitrogen fixation, *Denitrification, *Sediments, Bottom water, Rivers, Estuaries, Nitrogen, Nitrogen cycle, Nitrate, Ammonia, Carbon, Seasonal variation, *Acetylene reduction, *North Carolina, Pamlico River, *Pollutant identification, Water pollution sources.

Rates of nitrogen fixation in the sediment of the Pamlico River were measured from February 1982 to February 1983 using the acetylene reduction technique. Nitrogen fixation rates vied from 0.5 to 11.7 mu moles N2/m super 2hr and were greatest in the summer and late fall. Rates were shown to increase with increasing temperature, additional carbon substrate, and increasing concentration of acetylene incubated in the headspace. Furthermore, nitrate addition generally decreased rates, or had no effect, while ammonia addition decreased rates at the downriver station but had no effect at the upriver station. Rates of nitrogen fixation were found to be equal to the ammonia flux out of the sediment in winter, but were only five percent or less of the flux in the summer. Nitrogen fixation in the Pamlico River is probably limited by temperature in the winter and by a variety of factors in the summer, including availability of carbon and nitrogen. Rates of denitrification were measured from July 1982 to March 1983 using the acetylene blockage technique. Denitrification rates were not measurable unless nitrate was added, and were as large as 479 mu moles N sub 2/m super 2hr with 119 mu M nitrate added. Denitrification capacity was greatest during the winter when as much as 9.8% of added mitrate was used for denitrification. Denitrification in the Pamlico River sediments appears to be limited by the availability of nitrate.
W83-03712

THE EFFECTS OF BOTTOM WATER ANOXIA ON BENTHNIC NUTRIENT FLUX RATES IN THE PAMLICO RIVER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5C.
W83-03713

A STUDY OF RADIUM-226 AND RADON-222 CONCENTRATION IN GROUND WATER NEAR A PHOSPHATE MINING AND MANUFACTURING FACILITY WITH EMPHASIS ON THE HYDROGEOLOGIC CHARACTERISTICS OF THE AREA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
B. F. Mitsch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246983, Price codes: A06 in paper copy, A01 in microfiche. M. S. Thesis, 1982. 116 p, 38 Fig, 8 Tab, 33 Ref, 2 Append. OWRT B-145-NC(1), 14-34-0001-1258.

Descriptors: Groundwater, *Radioactivity, *Groundwater pollution, Geohydrology, Phosphates, *Mine drainage, Aquifers, Aquitards, Gamma radiation, Pumping, Drawdown, Leakage, Dewatering, Beneficiation, Gypsum, Uranium, *Kadium-226, *Radon-222, *North Carolina, Castle Hayne aquifer.

Samples of water from wells located near a phosphate mining and manufacturing facility were collected and analyzed for Radium-226 and Radon-222. Chemical separation and emanation techniques were utilized in the analyses. Results indicated that mining and manufacturing were not having a detrimental effect on the radionuclide concentrations in the ground water of the area. Natural hydrogelogic factors can account for the differences in radioactivity observed in the various aquifers sampled. Wells sampled repetitively over time did not exhibit any significant changes in radium or radon concentrations. Baseline data were established which can be used to evaluate possible future impacts on radio-nuclide concentrations in ground water resulting from expansion of mining activities.
W83-03714

SALT TRANSPORT IN THE LOWER SOUTH PLATTE RIVER,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. V. Gomez-Ferrer, and D. W. Hendricks.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249599, Price codes: A09 in paper copy, A01 in microfiche. Environmental Engineering Technical Report No 82-3141-01, Colorado State Univ., Fort Collins, January 1982. 167 p, 59 Fig, 25 Tab, 41 Ref,

Descriptors: *Salinity, *Salt balance, *Irrigation effects, Irrigation water, Dissolved solids, Water resources development, South Platte River, *Colorado, *Path of pollutants, Water pollution sources.

This work demonstrates how river salinity may be characterized, in terms of both time and space variations. Fifteen years of daily and monthly salinity and flow data have been reduced to monthly, seasonal, and annual statistical characterizations for five river stations and three tributary stations for the lower South Platte River. From these characterizations distance profiles were plotted for flow, TDS, and salt mass flows. point source discharges were the basis for a reach-by-reach materials balance analysis for four reaches of the South Platte River between Henderson and Julesburg. Return flows and return salt mass flows were computed as residuals. The analysis showed that there is not a salt balance in the lower South Platte River. A net salt loss to the land of 380 tons per day occurs by irrigation. The analysis provided can be the basis for a more comprehensive materials balance model. But the results can be used to estimate the impact of new water resources developments upon the salinity regime of the lower South Platte River.
W83-03718

AN INVESTIGATION OF THE CHEMISTRY OF DEGRADATION OF PESTICIDES AND OTHER SERIOUS ORGANIC CONTAMINANTS IN DRINKING WATER FOR APPLICATION TO DOMESTIC AND COMMUNITY WATER SUPPLIES,
New York State Coll. of Human Ecology, Ithaca. Dept. of Design and Environmental Analysis.
For primary bibliographic entry see Field 5F.
W83-03725

EFFECT OF SEEPAGE FROM UNLINED MUNICIPAL WASTE STABILIZATION LAGOONS ON CHEMICAL QUALITY OF GROUNDWATER IN SHALLOW AQUIFERS,
North Dakota Univ., Grand Forks. Dept. of Geology.
A. E. Kehew, D. J. Brown, and F. J. Schwindt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-248336, Price codes: A09 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State University, Fargo, December 1982. 183 p, 36 Fig, 3 Tab, 34 Ref, 6 Append. OWRT A-072-NDAK(1), 14-34-0001-1136.

Descriptors: *Groundwater, *Impoundments, *Lagoons, *Seepage, Aquifers, Coliforms, Water pollution, Sludge, Ammonium compounds, Adsorption, *North Dakota, *Stabilization lagoons, Path of pollutants.

Groundwater quality changes were investigated around six unlined municipal waste stabilization lagoons in North Dakota. The lagoons chosen were constructed in permeable sediments directly over shallow, unconfined aquifers. Groundwater contamination at all sites is characterized by a plume of water with low redox potential and high dissolved-solids content extending downgradient from the impoundments. At McVille, the site with the most severe contamination, untreated wastewater is maintained in one cell throughout the year except when short intermittent discharges of wastewater are made into an adjacent cell. Groundwater quality is much poorer downgradient from the intermittently-used cell relative to groundwater just downgradient from the primary cell. Seepage water quality is apparently better when adequate holding time is maintained in a cell with a basal slude layer. Water downgradient from the intermittently-used cell has a very high ammonium concentration, which is subsequently decreased by adsorption. Evidence suggests that coliform organisms can move several hundred feet away from the lagoons in groundwater under favorable conditions. Contamination at the other sites was not as severe as McVille although levels of some parameters exceed drinking water standards in the vicinity of the lagoons. Lagoons in geological settings similar to the study area should be lined, particularly if wells are nearby.
W83-03731

SIMULATION OF NUTRIENT, MICROORGANISM, AND HEAVY METAL TRANSPORT CAPACITY OF SUSPENDED SEDIMENT,
Arizona Univ., Tucson. School of Renewable Natural Resources.
For primary bibliographic entry see Field 2J.
W83-03732

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES V. KROMME AND GAMTOOS RIVER (ST. FRANCIS BAY),
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
R. J. Watling, and H. R. Watling.
Water SA, Vol 8, No 4, p 187-191, 1982. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Estuaries, *Trace metals, *Water pollution sources, Pollutant identification, Zinc, Cadmium, *South Africa, Gamtoos River, Kromme River, St. Francis Bay, Copper, Lead, Iron, Manganese, Nickel, Cobalt, Mercury, Sodium, Potassium, Cadmium, Magnesium.

During August of 1979 surveys were made to study the distribution of selected metals in the Kromme and Gamtoos Rivers. Water samples were analyzed for thirteen elements, and surface sediments core samples were examined for sixteen elements using atomic absorption spectroscopy. The distribution of metals in water, surface sediment and sediment core samples indicates that both rivers drain essentially unpolluted catchments. However, unusually high metal inputs were found at isolated sites in each river. Trace toxic metals are introduced into the Kromme River via the Geelhoutboom tributary as a result of the weathering of a local mineralized sequence. The effects of this input are distinguishable as far as the midstream island at the confluence of the two rivers. No anomalous metal levels are easily discernible downstream of this site. Anomalously high concentrations of manganese, copper, zinc, and iron were found in the region of the Gamtoos River mouth and nearby lagoon. These may be related to a combination of the use of certain agricultural products in the cultivated area of the flood plain and physico-chemical phenomena occurring in the upper lagoonal area. Surface water runoff would account for their presence in the water column, after which the usual sedimentary processes could cause their deposition at particular sites downstream. Overall metal levels in the Gamtoos River are slightly higher than those in the Kromme River. (Baker-FRC)
W83-03738

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES VI. SUNDAYS RIVER,
Port Elizabeth Univ. (South Africa).
R. J. Watling, and H. R. Watling.
Water SA, Vol 8, No 4, p 192-195, 1982. 1 Fig, 3 Tab, 3 Ref.

Descriptors: *Estuaries, *Metals, *Pollutant identification, Sediments, Mineralization, Zinc, Mercury, Manganese, Copper, Lead, Cobalt, Nickel, Chromium, Cadmium, Iron, Sundays River, *South Africa.

The distribution of selected metals was examined in the Sundays River during August 1979 and 1981. Surface sediment and water sample and sediment cores were analyzed for up to 16 elements using atomic adsorption spectroscopy. The findings indicate that the input of metals by man is insignificant. The increased levels of metals in the sediment column are probably derived from catchment weathering of mineralized zones, and metals are likely to be present in the stable sulfide form, making them relatively unavailable to the biota. The Sundays River is at present unpolluted with respect to metals, and unless further urban, agricultural, or industrial developments take place it should not be necessary to monitor the area. (Baker-FRC)
W83-03739

FACTORS INFLUENCING DIELDRIN AND DDT RESIDUES IN CARP FROM THE DES MOINES RIVER, IOWA, 1977-80,
Iowa Cooperative Fishery Research Unit, Ames.
W. H. Hubert, and E. D. Ricci.
Pesticides Monitoring Journal, Vol 15, No 3, p 111-116, December, 1981. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Pesticide residues, Fish, Fate of pollutants, *Dieldrin, *DDT, Insecticides, *Carp, Rivers, Reservoirs, Seasonal variation, Des Moines, *Iowa.

Carp from the Des Moines River, Iowa, were analyzed for dieldrin and DDT residues in 1980. Dieldrin levels were 10-128 micrograms per kg of flesh and 630-5790 micrograms per kg of fat. Differences in mean levels were statistically different among the 4 stations, with a tendency to higher levels at the 2 reservoir stations than at the river stations. Mean levels of dieldrin in fat and flesh declined from June to September. Total DDT levels were 18-191 micrograms per kg of flesh and 1090-9910 micrograms per kg of fat. Although the mean DDT levels were significantly different at the stations, there was no clear pattern with respect to reservoir vs. river samples. Mean levels of total DDT declined from June to September. (Cassar-FRC)
W83-03743

1,2-DIBROMO-3-CHLOROPROPANE RESIDUES IN WATER IN SOUTH CAROLINA, 1970-80,
Clemson Univ., SC. Dept. of Plant Pathology and Physiology.
G. E. Carter, Jr.,, and M. B. Riley.
Pesticides Monitoring Journal, Vol 15, No 3, p 139-142, December, 1981. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Pesticide residues, *Nematocides, *Fumigants, *South Carolina, Water analysis, Fate of pollutants, 1,2-Dibromo-3-chloropropane, Soil fumigants, Path of pollutants.

The soil fumigant and nematocide, 1,2-dibromo-3-chloropropane (DBCP), was determined in well water, surface water and muncipal water samples from 3 regions in South Carolina: Piedmont, no DBCP use; Sandridge, high DBCP use; and coastal, scattered DBCP use. Samples from the Piedmont contained a background level of DBCP, up to 0.05 ppb. In the coastal area DBCP levels in well water and municipal water samples did not exceed the background level; one surface water sample contained about 0.2 ppb. In the Sandridge area municipal water samples contained the background level of DBCP. 27% of the well water samples exceeded the background level. Of these, several from one small area exceeded 1 ppb DBCP. 37% of surface water samples from Sandridge exceeded the background level, but none were higher than 0.4 ppb. (Cassar-FRC)
W83-03744

THE NITROGEN BALANCE OF VEGETABLE CROPS IRRIGATED WITH UNTREATED EFFLUENT,
Chile Univ., Santiago. Dept. of Inorganic and Analytical Chemistry.
B. E. Schalscha, and F. I. Vergara.
Plant and Soil, Vol 67, No 1-3, p 221-226, 1982. 4 Tab, 11 Ref.

Descriptors: *Nitrates, *Wastewater irrigation, Nitrogen removal, Agriculture, Santiago, *Chile, Irrigation water, Fate of pollutants, Fertilizers.

Agricultural fields irrigated with untreated effluent from the sewers of Santiago, Chile, received 779 kg N per ha during a recent year. Of this, lettuce, spinach beet, and celery crops removed 161, 223, and 287 kg N per ha, respectively. Much of the excess N apparently migrates to the groundwater (water tables, 1-15 m deep in this region) as nitrate, since well water samples impacted by the effluent showed nitrate levels of 16.5 and 11.5 mg per liter. Total N in treated soil varied with depth from 0.02% at 70 cm and deeper to 0.28% in the upper 30 cm. Control soil contained only 0.06% N throughout its depth. (Cassar-FRC)
W83-03745

RATE OF DENITRIFICATION IN WATER BODIES OF AN IRRIGATION SYSTEM AND SOIL OF RICE FIELDS IN THE KARA KALPUK ASSR,
I. N. Krylova, and T. R. Babanazarov.
Water Resources (English Translation), Vol 9, No 2, p 199-203, March-April, 1982. 6 Tab, 8 Ref. Translated from Vodnye Resursy, No 2, p 116-121, March-April, 1982.

Descriptors: *Denitrification, *Irrigation practices, Rice, Floods, Lakes, Fertilizers, Phosphates, Nitrogen, Nitrates, Ammonium sulfate, *USSR, Kara Kalpuk ASSR.

The agrochemical and microbiological characteristics and results of determinations of the activity of biological denitrification in the bottom sediments of the water bodies of the irrigation system and soils of rice fields are presented. Field experiments were conducted during July and August of 1979 and May to July of 1980. One of the study fields was strongly saline field, where rice was sown for the first time. The second field was in the eighth year of use. Before sowing rice, 500 kg of superphosphate and 700 kg of ammonium sulfate were applied per hectare. During the growing season 200 kg of ammonium sulfate per hectare was applied additionally. The total amount of nitrogen applied was 191 kg/ha. The water layer in the paddies was kept at the level of 15-20 cm. Soil samples for analysis were taken from various horizons to a depth of 10 cm at two points. The nitrogen content changes most substantially after flooding the soil of the rice fields. Thus, a deficit of nitrogen-containing substances was formed under reducing conditions in sulfate-calcareous soil, where the total nitrogen content dropped from 2.37 to 0.78 mg N/g dry soil, and also in the rhizosphere of rice in calcareous soil, where it decreased from 3.70 to 1.44 mg N per g dry soil. On the basis of analyses of the activity of microbiological processes it was calculated that during the growing season about 8 kg N/ha is denitrified on calcareous soil and about 44 kg N/ha sulfate-calcareous soil, which is equal respectively to 4 and 23% of the amount of nitrogen applied to the fields with fertilizers. However, in sulfate-calcareous soil rich in active cations the total nitrogen increases due to washing out of nitrates and ammonium. The rate of denitrification in water bodies of the irrigation system is comparable to that in soils of the rice fields. Denitrification attains maximum activity in peripheral lakes. (Baker-FRC)
W83-03760

SALT STATUS OF GLACIAL TILL SOILS OF NORTH-CENTRAL MONTANA AS AFFECTED BY THE CROP-FALLOW SYSTEM OF DRYLAND FARMING,
Montana Agricultural Experiment Station, Bozeman.
For primary bibliographic entry see Field 2G.
W83-03769

ANIMAL FEEDLOT RUNOFF IN THE PIEDMONT,
Clemson Univ., SC. Dept. of Agricultural Engineering.
R. O. Hegg, C. L. Barth, and W. H. Hanvey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-248393, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 109, July 1983. 28 p, 4 Fig, 4 Tab, 20 Ref, 3 Append. OWRT B-126-SC(1), 14-34-0001-9133.

Descriptors: *Surface runoff, Runoff volume, *Feedlot runoff, Animal wastes, Rainfall intensity, *Erosion, Runoff, *Rainfall-runoff relationships, Settling basins, *South Carolina, Piedmont region.

Animal feedlots are characterized by compacted soils and a lack of vegetation. In the South Carolina Piedmont Region high annual rainfalls (55 in/yr) on the animal feedlots can cause polluted water to enter streams and lakes. This three year study was conducted at a 10.19 acre feedlot at the Clemson University Simpson Experiment Station. A sampling station was constructed to measure the

quantity and quality of the runoff from the feedlot. A majority of the rainfall intensities ranged from 0.01 to 0.2 in/hr, but with the maximum reaching 0.6 in/hr. There was a wide variability in the percentage of the rainfall leaving the feedlot as runoff (0 - 90%) which was due to the rainfall duration, rainfall intensity, vegetation cover and preceeding moisture conditions. The average sediment loss from eleven storms when there were no animals on the feedlot was 5.4 lbs/ac and from 35 storms with animals on the feedlot the average was 20.3 lbs/ac. Both of these values are quite low and would cause no serious erosion problems on slopes of 2 - 5% at the animal stocking rates(4000-9000 ft super 2/hd) encountered in this study. There was a wide range in the water quality characteristics of the runoff. Typical average values by storm were as follows pH:, 6.5-7.2; total coliform bacteria, 6E5-3E7 (colonies/100ml); fecal coliform, 0.2E6 (colonies/100ml); TOC, 4-900; total kjeldahl nitrogen, 2-30; TP, 1-50; COD, 30-1400; FS, 300-3400; VS, 200-2000; nitrate -N, 0.2-10 and ammonia-N, 1-10 (all as mg/L unless otherwise noted).
W83-03775

TRICKLE IRRIGATION - MODELING WATER AND SOLUTES,
Arizona Univ., Tucson. Dept. of Mathematics.
For primary bibliographic entry see Field 2G.
W83-03777

PLASTIC PELLETS ON SPAIN'S 'COSTA DEL SOL' BEACHES,
Shiber Consultants, Safat (Kuwait).
J. G. Shiber.
Marine Pollution Bulletin, Vol 13, No 12, p 409-412, December, 1982. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Water pollution sources, *Industrial wastes, *Plastic industry, Plastic, Costa del Sol, *Spain, Polyethylene.

Plastic pellets were found on the beaches of the Costa del Sol of Spain. The pellets were primarily of the low density polyethylene type. Some degradation was noted. The rest of the pellets were either high density polyetylene or ethylvinyl acetate. None was polystyrene. The largest accumulation probably occurs during the winter months when the beaches are more or less neglected and the sea is most turbulent. In Estepona, the pellets were most abundant at the end of November 1980 after a few winter storms had occurred. At least seven plastic factories operate in the vicinity of the Costa del Sol. Careless disposal practices of these factories or losses of raw materials during sea shipment or unloading at ports are possible and very likely sources of this pollutant. The absence of crazing and encrusting biota on the pellets suggests that their introduction to this environment was relatively recent. (Baker-FRC)
W83-03785

FACTORS AFFECTING THE SOLUBLE-SUSPENDED DISTRIBUTION OF STRONTIUM-90 AND CESIUM-137 IN DARDANELLE RESERVOIR, ARKANSAS,
Arkansas State Univ., State University. Dept. of Chemistry.
D. M. Chittenden, II.
Environmental Science and Technology, Vol 17, No 1, p 26-31, January, 1983. 2 Fig, 4 Tab, 18 Ref.

Descriptors: *Radioisotopes, *Sediments, *Reservoirs, Fate of pollutants, Radioactive wastes, Strontium radiosotopes, Cesium radioisotopes, Suspended sediments, Bottom sediments, Dardanelle Reservoir, *Arkansas, Powerplants, Nuclear reactors, Adsorption, Clays.

Concentrations of Sr90 and Cs137 were determinded in suspended and bottom sediments from the Dardanelle Reservoir, Arkansas, used as a cooling water source by a nuclear powerplant. Analysis of the levels of radionuclides with respect to the concentration of ionic species and the radioactivity released from the plant showed that the sorbed Sr90 level had an inverse relationship to the concentration of alkaline earth cations. The main source of the Sr90 (0.50 pCi per liter) was fallout rather than releases from the reactors. This radionuclide has been in the system long enough to reach equilibrium between solution and suspended sediments. Bottom sediments had slightly higher Sr90 concentrations than suspended sediments. The concentration of Cs137 was dependent on total activity released from the reactors. An equilibrium between sorbed and dissolved Cs137 has not been reached in the reservoir because there is constant input from the reactors and the required time for reaching equilibrium is greater than the residence time in the reservoir. (Cassar-FRC)
W83-03795

SOURCES OF TRIHALOMETHANES AND OTHER C1 AND C2 HALO-ORGANICS IN POTABLE WATER,
For primary bibliographic entry see Field 5F.
W83-03799

CU, CD AND ZN IN BLANCA BAY SURFACE SEDIMENTS, ARGENTINA,
Instituto Argentino de Oceanografía, Buenos Aires. Lab. de Quimica Marina.
J. L. Sericano, and A. E. Pucci.
Marine Pollution Bulletin, Vol 13, No 12, p 429-431, December, 1982. 4 Fig, 2 Tab, 4 Ref.

Descriptors: *Sediments, *Metals, *Bays, Surface sediments, Copper, Zinc, Cadmium, Blanca Bay, *Argentina, Water pollution sources, Fate of pollutants.

Evaluations were made of contamination of seawater and surface sediments of Blanca Bay caused by industrial activity and urban centers in this region. Concentrations and distributions of copper, cadmium and zinc in these sediments that correspond to the NW limits of Blanca Bay are reported, along with the textural character of these sediments. Reference values were sought to be used in the future to measure the changes produced by an increase in contamination. Water drained from almost 4200 sq km of cultivated land plus the urban wastes of nearly 300,000 inhabitants of Bahia Blanca with a large industrial zone are discharged directly to the seawater. The area behaves as an estuary in periods of heavy rainfall. In general, spatial variations were found in the concentrations of the trace metals at each station from one cruise to another. Some of the variations indicate a clear influence from two important contaminating centers, the municipal garbage dump and the emptying of the main sewer of Bahia Blanca. Sampling stations located in places far away from the urban centers showed a more uniform distribution of values. The relationship between metal contents and pelitic percentages in the Blanca Bay area indicates a direct correlation for copper and zinc. Surprisingly high values of copper and zinc were present in low percentage pelite sediments. Cadmium showed no clear correlation with sediment texture. The average levels for these three metals found in the surface sediments from Blanca Bay are considerably lower than those found in estuaries and bays located in other geographic regions. (Baker-FRC)
W83-03802

HEAVY METAL DISTRIBUTION IN SEDIMENTS FROM THE GULF OF CATANIA (ITALY),
Catania Univ. (Italy). Ist. di Biologia Generale.
A. Castagna, F. Sarro, F. Sinatra, and E. Console.
Marine Pollution Bulletin, Vol 13, No 12, p 432-434, December, 1982. 6 Fig, 1 Tab, 8 Ref.

Descriptors: *Sediments, Metals, *Gulfs, Gulf of Catania, *Italy, *Path of pollutants, Chromium, Copper, Cadmium, Zinc, Lead, Rivers, Simeto River, San Leonardo River, *Heavy metals.

Samples from 39 stations were tested for heavy metal distribution in the sediments of the Gulf of Catania. For zinc, chromium, lead, and copper there were strips of similar concentrations running parallel to the coastline, with values increasing proceeding from the shore out to sea. The majority of the area investigated has metal concentrations within the normal range for unpolluted areas, except for certain zones where a specific type of hydrography was caused by the waste water drains of the metalworking factories which enter the sea either directly or through the river Simeto. The stretch of sea studied is characterized by a current flowing southwards from the strait of Messina which, at the level of Capo S. Panagia, moves out to sea in the direction of the Sicilian channel. The presence of this current sets up a countercurrent flowing from south to north just off the coast. This countercurrent carries solid matter toward the port of Catania, which is thus subject to silting. Two rivers, Simeto and San Leonardo, enter the sea along the Catania Plaia beach, and thus transport sedimentable solids that contribute to this problem. As a result of hydrodynamic thrust, the clayey mass coming from the river goes out to sea and forms sediments. (Baker-FRC)
W83-03803

SILICONES IN CHESAPEAKE BAY SEDIMENTS,
Naval Research Lab., Washington, DC.
R. E. Pellenbarg.
Marine Pollution Bulletin, Vol 13, No 12, p 427-429, December, 1982. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Sediments, *Silicones, *Water pollution sources, *Fate of pollutants, Precipitation, Flocculation, Chesapeake Bay, Dispersion.

The dispersal of silicones in a large spatial context was investigated using a suit of sedimentary samples from the Chesapeake Bay. In the upper reaches of the Chesapeake Bay, sedimentation appears widespread, though sedimentation is often most concentrated at shoal locations. These are shore regions in the southern bay, so that sedimentary silicone is highest at the end stations of the down bay transects. The Chesapeake Channel, running along the axis of the Bay from near Annapolis to the bay mouth, accumulates neither organic-rich sediments nor silicones. The transect where the shallow upper bay gives way to the channel may be likened to the shelf-beak seen as one leaves a sea coast for deep waters. This is an area of high sedimentation, a process which could tend to homogenize and trap silicones moving downstream from such sources as Baltimore. Alternatively, materials from the Annapolis region would easily settle out in the general region of the transit. Urban influences are not clearly shown in this study. Thus there were two major trends. First, sedimentary silicones respond to physicochemical processes affecting other components of the sediment system. The major process may be flocculation of silicone-bearing particles. Second, it appears that the processes which remove silicone-bearing materials from the water column may be quite rapid. Silicones from Chesapeake Bay sediments do not definitely appear to have migrated from more diffuse source areas. (Baker-FRC)
W83-03804

2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN SEDIMENT SAMPLES FROM LOVE CANAL STORM SEWERS AND CREEKS,
New York State Dept. of Health, Albany.
For primary bibliographic entry see Field 5A.
W83-03814

EVALUATION OF ACID-MINE-WATER GENERATION AND ACID-MINE-DRAINAGE POTENTIAL OF COAL AND COAL-ASSOCIATED ROCKS,
West Virginia Univ., Morgantown. Water Research Inst.
J. J. Renton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-253328, Price codes: A02 in paper copy, A01 in microfiche, Completion Report, August 1983. 7 p. A-044-WVA(1), 14-34-0001-2152.

Descriptors: *Acid mine drainage, Geochemistry, *Land reclamation, *Pyrite, *Sulfides, *Water pollution sources, Chemical properties, Chemical Reactions, Iron compounds, Management planning,

Mine Drainage, Mine wastes, Mineralogy, Strip mine wastes, Sulfur compounds, *West Virginia.

Control or prevention of the drainage of acid mine water into streams is perhaps the greatest water problem in West Virginia and in the coal-mining areas of the region. After many years and much effort, the basic characteristics of the material, generally accepted as pyrite, that yields the acid are still not adequately understood. Planning, management, and control of this toxic pollutant are hindered without a sufficient understanding of the mechanisms of acid formation. This project was a small part of a continuing research effort of the principal investigator to gain a sufficient understanding of the mechanisms of mine-acid formation. A single 24-hour leaching of acid-producing materials yields an acid load of the same relative magnitude as extended leaching-reoxidation cycles. The best parameter for estimating acid yield is total-rock iron, followed by total-rock sulfur. For greater than half an inch, particle size appears not to influence the rate of acid yield; below that, yield increases exponentially decreasing size. The most reactive morphological form of pyrite is the massive variety; not the framboidal.
W83-03820

POLLUTANT LOADING MODEL FOR HIGHWAY RUNOFF,
Systems Architects Engineers, Inc., Seattle, WA.
T. W. Chui, B. W. Mar, and R. R. Horner.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1193-1210, December, 1982. 4 Fig, 11 Tab, 24 Ref.

Descriptors: *Water pollution sources, *Fate of pollutants, *Storm runoff, Model studies, *Pollution load, *Highway effects, Storm water, Urban runoff, Storms, Pollutants, Environmental effects, Suspended solids, *Washington.

Data from composite sampling of about 500 storm events at nine locations in Washington State were used to formulate a stormwater runoff pollutant loading model to describe the mechanisms of highway and traffic pollution of stormwater runoff. The model incorporates an expression relating total suspended solids (TSS) load to motor vehicle traffic, runoff coefficient, and surrounding land use contributions. Other contaminants such as volatile suspended solids, chemical oxygen demand, total organic carbon, total Kjeldahl nitrogen, nitrate, nitrite, total phosphorus, copper, zinc and lead are estimated from TSS load using load ratios derived from the data. These ratios may be taken as constants at any Washington state location for some pollutants or as a linear function of traffic volume for others. The model is useful in forecasting cumulative pollutant loadings in runoff from highways constructed in locations where climatic, soil, and land use conditions are similar to those at the sampling sites used to construct the data base. It is capable of predicting loadings over a time span encompassing a number of storms, but has little precision when applied to individual storm events. (Geiger-FRC)
W83-03829

COASTAL POLLUTION FROM SEPTIC TANK DRAINFIELDS,
North Carolina Dept. of Natural Resources and Community Development, Raleigh.
A. M. Duda, and K. D. Cromartie.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1265-1279, December, 1982. 5 Fig, 3 Tab, 17 Re f.

Descriptors: *Septic tanks, Tidal basins, *Coastal zone management, *Water pollution sources, *Coliforms, *Viruses, Septic wastewater, Tidal flats, Tidal rivers, Tide lands, Coastal waters, Shellfish, *North Carolina.

Bacterial and viral contamination of the coastal waters of North Carolina, a major shellfish harvesting area, has become a great concern in recent years due to the increase in residential communities with septic tank systems. The densities of coliform bacteria in six tidal watersheds draining residential areas of coastal North Carolina were monitored by wet and dry weather sampling techniques. Bacterial levels were compared with those of unsewered residences in each watershed. The ability of developed soils to assimilate septic tank effluents was also taken into account. Statistical analysis of the data implicated septic tank drainfields installed in unsuitable soils as a major source of contamination of coastal shellfish waters. Several common sense management practices were recommended to reduce the risk of further pollution. It was suggested that sufficient rural areas be maintained in each watershed to provide dilution water to allow easier assimilation of pollutant loads, that pollution sources be prevented from intermingling with tidal creeks, and that only properly functioning septic systems be allowed to function within coastal areas. (Geiger-FRC)
W83-03836

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN: III. PHOSPHORUS,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
M. H. Miller, J. B. Robinson, D. R. Coote, A. C. Spires, and D. W. Draper.
Journal of Environmental Quality, Vol 11, No 3, p 487-493, 1982. 3 Fig, 4 Tab, 19 Ref.

Descriptors: *Phosphorus, *Great Lakes, *Agricultural watersheds, Watersheds, Fate of pollutants, Water pollution sources, Nonpoint pollution sources, Pollution loads, Ontario, Water quality, Streams, Farm management, Runoff, Agricultural runoff, Erosion, Clays, Livestock, Farm wastes, Animal wastes.

Phosphorus contributions to the Great Lakes from agricultural activities in the Canadian basin were determined, using data from 1975-76, by two methods: (1) relating measured P loads at the outlets of 10 representative watersheds to land characteristics and agricultural activities, and (2) estimation of contributions from cropland runoff, livestock runoff, unimproved land runoff, and streambank erosion from studies of each source. Percent clay in the surface soil and the proportion of the area in row crops accounted for 85% of the variability in total P unit area loads from the watersheds. Dissolved reactive P unit area loads were related to clay content of surface soil and the P added to soils in the watershed. The total P load to the Great Lakes from the 300 subbasins of the agricultural region of the basin was estimated at 3000 tons per year, of which 2100 tons was attributed to cropland runoff, 600 tons to livestock operations, and 150 tons each to streambank erosion and unimproved agricultural land. Half of the total P load entered Lake Erie, the remainder being divided between Lake Huron and Lake Ontario. (Cassar-FRC)
W83-03841

5C. Effects Of Pollution

CONCENTRATION OF HEAVY METALS IN FISHES FROM THE RIVER DANUBE (SCHWERMETALLGEHALT VON FISCHEN AUS DER DONAU),
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
B. Wachs.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 15, No 2, p 43-49, 1982. 5 Fig, 3 Tab, 36 Ref.

Descriptors: *Heavy metals, *Fish, Rivers, *Public health, *Water pollution effects, Aquatic animals, Chubs, Pike, Cadmium, Zinc, Copper, Mercury, Muscle, Liver, Kidneys, Federal Republic of Germany, Danube River.

In 1977 through 1980, the heavy metal content of fish from the Bavarian Danube area was determined. More than one hundred fish were netted in the area between km 2250 and km 2420 and analyzed. Species included chub (Leuciscus cephalus), Vimba bream (Vimba vimba), bream (Abramis brama) and pike (Esox lucius). Concentrations of the heavy metals Cd, Cr, Cu, Fe, Hg, Ni, Pb, and Zn were determined in muscle, liver, and kidney tissues. In fish muscle, the concentrations of heavy metals were in the following sequence (wet weight): Zn > Cu > Hg > Cd. The highest concentration of Cd and Zn in organs was found in the kidney. Cu was accumulated mostly in the liver, and Hg in the muscle. Only Cd levels were found to exceed the Federal health authority tolerance limit for human health. In 4% of the fish the muscle contained 0.06-0.10 mg/kd Cd. The concentration of heavy metals in fish is primarily related to the level of heavy metal in the water. Accumulation in fish is a result of the aqueous milieu and is not an effect of the food chain. For the heavy metals studied, there was no biomagnification within the aquatic fauna. (Author's abstract)
W83-03504

TOXICITY OF ORGANOLEAD COMPOUNDS: STUDY OF BACTERIAL INACTIVATION BY MEASUREMENT OF ATP (APPROCHE DE LA TOXICITE DES ORGANO PLOMBS ETUDE DE L'INACTIVATION BACTERIENNE PAR MESURES D'ATP),
Centre Oceanologique de Bretagne, Brest (France).
J. L. Charlou, G. Martin, M. Chaussepied, and A. Houeix.
Progressive in Water Technology, Vol 12, No 4, p 501-512, 1980. 9 Fig, 35 Ref.

Descriptors: *Lead, *Sewage bacteria, *Sediment-water interfaces, Wastewater, Activated sludge process, Water analysis, Chemical analysis, Interfaces, Bacteria, Activated sludge, *Toxicity, Denitrification, Adenosine triphosphate, France, Seawater, Microbiology, Organic compounds.

Organo-lead compounds were investigated as part of a larger geochemical project based on the study of elements or non-naturally occurring compounds which are accidentally discharged in to sea. Laboratory simulations of damaging conditions created by alkyl-lead compounds and their effects on marine organisms were investigated in order to evaluate the contamination effects on bacteria at the water-sediment interface. The study model used a denitrifying activated sludge because of the insolubility and the density of the organometallic compounds. Bacterial activity was calculated by measuring the speed of denitrification and by the presence of biomass. These are determined by measuring the amount of adenosine triphosphate (ATP). The lack of response to the toxic product is followed by the lowering of the denitrification speed and by the change in ATP. The following compounds were studied: Et(4)Pb, Et(3)PbCl, Et(2)PbC1(2), and PbC1(2). (Author's abstract)
W83-03510

SANITARY MONITORING OF SEAWATER IN BATHING AREAS OF FRANCE (SURVEILLANCE SANITAIRE DES EAUX DE BAIGNADE EN MER EN FRANCE),
Ministere de la Sante et de la Securite Sociale, Paris (France)
For primary bibliographic entry see Field 5G.
W83-03515

ACIDIFICATION EFFECTS ON MACROINVERTEBRATES AND FATHEAD MINNOWS (PIMEPHALES PROMELAS) IN OUTDOOR EXPERIMENTAL CHANNELS,
Saint Olaf Coll., Northfield, MN. Dept. of Biology.
J. A. Zischke, J. W. Arthur, K. J. Nordlie, R. O. Hermanutz, and D. A. Standen.
Water Research, Vol 17, No 1, p 47-63, January, 1983. 9 Fig, 5 Tab, 34 Ref.

Descriptors: *Invertebrates, *Fish, *Acidic water, *Water pollution effects, Aquatic life, Macroinvertebrates, Benthic fauna, Streams, Hydrogen ion concentration, *Fathead minnows, Species diversity, Metals, Aquatic insects, Aquatic life, Toxicity.

The effects of acidification of stream water on macroinvertebrate communities and fathead min-

nows (Pimephales promelas) were studied in 3 outdoor artificial channels at Monticello, Minnesota, during May-September 1979. Channel sections 122 m long and containing two mud buttom pools and two riffles each were used. The control channel had an ambient pH of 8; the others were acidified with sulfuric acid to pH 5 and 6. Macroinvertebrate densitites at the start of the study were 8414, 14789, and 20398 per sq m for channels of pH 8, 6, and 5, respectively. During June the control riffles had greater densities than the acidified riffles. By September the acidified riffles had 38-71% higher densities than the ambient riffles due to an increase in amphipod numbers. The numbers of insect taxa emerging from the control, pH 6 and pH 5 channels were 30, 28, and 18, respectively. Damselflies, isopods, and leeches were most tolerant to acid; chironomids, some amphipods (Crangonyx), and flatworms had intermediate tolerance; and other amphipods (Hyalella azteca) and snails (Physa gyrina) were most sensitive. Fathead minnow spawning and embryo production were similar in control and pH 6 channels, but little spawning and no eyed-embryos were found in the pH 5 channel. Larval fish did not survive to the juvenile stage in the pH 6 channel. (Cassar-FRC)
W83-03532

ENVIRONMENTAL LIMITING FACTORS AFFECTING THE GROWTH AND SPREAD OF CHALCALBURNUS TARICHI (PALL. 1881) (PISCES: CYPRINIDAE) IN BURDUR LAKE (DIE UMWELTFAKTOREN, DIE DIE VERBREITUNG UND ENTWICKLUNG VON CHALCALBURNUS TARICHI (PALL. 1881) (PISCES: CYPRINIDAE) IN BURDUR-SEE BEGRENZEN),
Istanbul Univ. (Turkey). Fen Fakultesi.
F. Aksiray.
Water Research, Vol 16, No 7, p 1107-1112, July, 1982. 2 Fig, 5 Tab, 21 Ref.

Descriptors: *CLosed lakes, *Brackish lakes, *Fish establishment, *Water pollution effects, Fish populations, Water analysis, Oxygen, Hydrogen sulfide, Food-processing wastes, Industrial wastes, Chemical analysis, Plankton, Aquatic life, Bottom sediments, Bottom sampling, Biological samples, Lake fisheries, Burdur Lake, *Turkey.

Productivity losses in the introduced fish Chalcalburnus tarichi in Burdur Lake were investigated through hydrobiological studies. The closed brackish lake has an area of 190 sq km and a depth of 76 m. Since 1969, two research stations have collected water, plankton, and bottom samples. Water samples were collected using Nansen bottles at 10 m intervals from the surface to the bottom. Chemical analysis was performed, including determination of dissolved oxygen. Plankton was collected in 10 m intervals using a Closing net, and plankton per cu m was determined. Ekman's dredge was used to collect bottom sediment, and biological content was determined. Wastewaters containing organic matter flow into the lake from the Burdur Sugar Mill, milk and cheese factories, the Attar of Rose industries, and hemp (Cannabis sativa) industries. An anoxic water layer containing hydrogen sulfide is formed above these wastes. The anoxic water layer has been increasing in thickness by 2 to 2.5 m per year. This has an adverse effect on bottom feeding and plankton populations, and thus affects the Chalcalburnus tarichi population. The future of the lake and its environment is threatened. (Small-FRC)
W83-03543

INFLUENCE OF MICROPOLLUTANTS ON VEGETATION,
Water Research Centre, Stevenage (England).
R. D. Davis.
Water Science and Technology, Vol 14, No 12, p 31-44, 1982. 7 Fig, 1 Tab, 20 Ref.

Descriptors: *Vegetation, *Water pollution effects, *Micropollutants, Land application, Sludge disposal, Metals, Herbicides, Organic compounds, Phytotoxicity, Soil properties.

Potentially phytotoxic inorganic and organic micropollutants are listed, and some of their effects are described. The use of plant analysis for assessing phytotoxicity in terms of relative pollution hazard is discussed. The discharges of sludges and effluents are facets of the water cycle which result in exposure of plants to micropollutants. When sewage sludge is applied to agricultural land, determination of total concentrations of micropollutants in soils indicates only the extent of contamination. Its significance in terms of phytotoxicity and transfer to food chains depends on soil conditions and crop type. Biological toxicity tests can be used both to screen for phytotoxicity in sludges and effluents before their discharge and to trace sources of phytotoxic pollutants. Inorganic micropollutants with potentially phytotoxic properties which are most commonly encountered in the water cycle include certain heavy metals and their compounds. Organic micropollutants of greatest significance to plants include herbicides and their residues. The use of sewage sludge on agricultural land and the use of river water and effluents for crop irrigation are two instances in which exposure of plants to micropollutants will occur. (Baker-FRC)
W83-03552

NATURE AND ORIGIN OF MICROPOLLUTANTS,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
For primary bibliographic entry see Field 5B.
W83-03555

TEACHER'S RESOURCE GUIDE ON ACIDIC PRECIPITATION WITH LABORATORY ACTIVITIES,
Maine Univ. at Orono. Coll. of Education.
For primary bibliographic entry see Field 2K.
W83-03565

FACTORS REGULATING NUISANCE BLUE-GREEN ALGAL BLOOM POTENTIALS IN THE LOWER NEUSE RIVER, N.C.,
North Carolina Univ. at Chapel Hill. Inst. of Marine Sciences.
Hans W. Paerl.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-227413, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 188, North Carolina State Univ., Raleigh, May 1983. 55 p, 17 Fig, 22 Ref. OWRT A-122-NC(1), 14-34-0001-1135.

Descriptors: *Eutrophication, *Nuisance Algae, *Nutrients, Limiting Nutrients, Nitrogen, Nitrate, Phosphorus, *Cyanophyta, Primary productivity, Algal growth, *North Carolina, Neuse River.

Bi-weekly examinations of physical, chemical, and biotic factors, involved in the establishment and proliferation of blue-green algal (Microcystis aeruginosa) blooms in the lower Neuse River indicated several causative agents. Included are: (1) excessive concentrations of both nitrogen and phosphorus throughout much of the year and (2) periods of low flow and decreased turbulence (vertical mixing), leading to thermal stratification of the water column. Periods of thermal stratification, even lasting only a day or two, are instrumental in promoting dominance by surface-dwelling Microcystis populations. A combination of these physical and chemical agents leads to maximal bloom development. It was determined that bloom regulation by temperature is secondary to regulation by other physical factors and nutrient sufficiency. Also, periodic salinity intrusions into the lower river are ineffective in arresting Microcystis bloom potentials, particularly in surface waters where bloom intensity is often most severe. Nutrient-dilution bioassays were used to determine which nutrients were closest to 'limiting' concentrations. Preliminary experiments indicate that nitrogen, largely as NO sub 3-, reductions (of at least 30%) are more effective than phosphorus reductions in arresting bloom potential. These findings dictate an immediate concern for stemming nitrogen loading. Parallel decreases in phosphorus loading would be also desirable in the long run. Nitrogen constraints without parallel phosphorus constraints may promote N sub 2-fixing nuisance blue-green algae, such as Anabaena, as opposed to the non-N sub 2-fixing Microcystis.
W83-03566

THE FATE, DISTRIBUTION AND LIMNOLOGICAL EFFECTS OF VOLCANIC TEPHRA IN THE ST. JOE AND COEUR D'ALENE RIVER DELTAS OF LAKE COEUR D'ALENE, IDAHO,
Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
For primary bibliographic entry see Field 5B.
W83-03597

A PRELIMINARY INVESTIGATION INTO THE USE OF CRAYFISH AS A SENSITIVE SPECIES TO POLLUTANTS IN THE CLARK FORK RIVER NEAR MISSOULA, MT,
Montana Univ., Missoula. Dept. of Botany.
For primary bibliographic entry see Field 5B.
W83-03617

NUTRIENT AND MULTI-SPECIES CRITERIA STANDARD FOR THE CHOWAN RIVER, NORTH CAROLINA,
North Carolina State Univ. at Raleigh. Dept. of Botany.
A. M. Witherspoon, and R. Pearce.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-236158, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 187, North Carolina State Univ., Raleigh, December 1982. 168 p, 133 Fig, 24 Tab, 56 Ref. OWRT B-127-NC(6), 14-34-0001-0274.

Descriptors: *Eutrophication, *Nutrients, *Nutrient requirements, *Phytoplankton, *Algae, Biomass, Chlorophyll A, Cyanophyta, Microcystis, Anabaena, Aphanizomenon, Nitrogen, Ammonia, Nitrate, Phosphorus, Phosphate, Water temperature, *North Carolina, Chowan River.

An investigation of changes in nutrient concentrations, phytoplankton biomass, and environmental parameters in the Chowan River Complex (CRC) was conducted from October 1978 through December 1981. The response of phytoplankton to a given concentration of a given nutrient was determined using a growth response ratio (RR) for each nutrient relative to chlorophyll-a and algal wet weight biomass. Species of the three genera that periodically bloom in the river were isolated and a minimum nutrient requirement for each was determined. The results suggest that the CRC is in excess of necessary nutrients for moderate algal growth. In the order of descending nitrogen requirements for initiating cyanophyceae algal growth, the species were: Microcystis, Anabaena and Aphanizomenon. Initiating P0 sub 4 concentrations depended upon the physiological state of the species and the light and temperature regime to which they were exposed. Using the extent to which RR sub N03, RR sub NH4 and RR sub OP exceed the efficiency level of 1.0 per chlorophyll-a, reductions of 48% NO sub 3 23% NH sub 4 and 27% OP would be required for algal biomass (as chloro-a) to be reduced to 40 mug/l; the margin determined as the maximum desirable, concentration for the CRC. Because blue-green algae are 'luxury consumers' of PO sub 4, both PO sub 4 nitrogen should be reduced simultaneously. These results are discussed as they might relate to management of the CRC.
W83-03623

RESERVOIR EUTROPHICATION AND MANAGEMENT,
Lycott Environmental Research, Inc., Southbridge, MA.
For primary bibliographic entry see Field 5G.
W83-03629

IMPACT OF SNOWMELT-RUNOFF FROM AGRICULTURAL WATERSHEDS ON DISSOLVED OXYGEN,

Wisconsin Dept. of Natural Resources, Rhinelander.
For primary bibliographic entry see Field 5B.
W83-03636

ECONOMIC RESEARCH NEEDS RELEVANT TO IMPROVED DRINKING WATER QUALITY,
Resources for the Future, Inc., Washington, DC.
For primary bibliographic entry see Field 6B.
W83-03637

FATE OF HERBICIDES IN GROUNDWATER AND SURFACE RUNOFF AND THEIR BIOTIC EFFECTS ON PRAIRIE POTHOLES,
North Dakota Univ., Grand Forks. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W83-03682

EFFECTS ON CHANNEL CATFISH OF HIGH NITRITE CONCENTRATIONS THAT OCCUR IN FISH PONDS,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
J. M. Grizzle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246470, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Auburn, Ala., June 1983. 6 p, 5 Ref. OWRT A-079-ALA(1), 14-34-0001-2101.

Descriptors: *Fish diseases, *Nitrite, *Catfish, Aquaculture, Water pollution effects, Toxcity, Animal pathology, Pathogenic bacteria, Aeromonas, Myxobacteria.

The concentraton of nitrite lethal to one-half (LC50) of the channel catfish Ictalurus punctatus in a 96-hour, flow-through toxicity test was 13.7 mg/liter. A high percentage of methemoglobin caused the blood to be brown and was the most consistent effect of nitrite exposure. Chronic exposure to nitrite caused degeneration of erythrocytes and lactic acidosis. Histological lesions were not found in nitrite-exposed fish, but vacuolation of hepatocytes due to glycogen decreased in fish with methemoglobinemia. The percentage of methemoglobin decreased during chronic exposure, and this apparent acclimation may explain the ability of nitrite-exposed fish to grow at the same rate as controls during a 4-month experiment. Exposure to 5 mg/liter nitrite predisposed channel catfish to infection by Aeromonas hydrophila and Flexibacter columanris, common bacterial pathogens of fish. Fish exposed to 4.5 mg/liter nitritehad lower antibody titers 14 days after vaccination than vaccinated controls. This inhibition of antibody production may be related to the increased susceptibility of nitrite-exposed channel catfish to bacterial infection. This study demonstrated that nitrite concentrations as low as 4-5 mg/liter have prolonged effects on channel catfish, including increased suspectibility to bacterial diseases.
W83-03698

EFFECTS OF ACID DEPOSITION (RAIN) ON A PIEDMONT AQUATIC ECOSYSTEM: ACID INPUTS, NEUTRALIZATION, AND PH CHANGES,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
A. W. Elzerman, and R. W. Talbot.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246496, Price codes: A05 in paper copy. A01 in microfiche. Water Resources Research Institute Publication No 108, Clemson Univ., SC., May 1983. 79 p, 10 Fig, 17 Tab, 35 Ref. OWRT B-141-SC(1), 14-34-001-1262.

Descriptors: *Acid rain, *Air pollution effects, *Chemistry of precipitation, Aquatic environment, Areal precipitation, Cation exchange, Earth-water interfaces, Enviromental effects, Geochemistry, Hydrogen ion concentration, Ion exchange, Leaching, Pollutants, Rainfall impact, Stream pollution, *South Carolina, Lake Issaqueena.

The overall objective of the investigation was to make an initial assessment of the significance of acid deposition to lakes in the South Carolina Piedmont and nearby southern Appalachian Mountains and conduct an intensive investigation of a selected watershed (Lake Issaquenna, Pickens County, South Carolina). Amounts and types of acid inputs, storm event changes in streamwater chemistry, the influence of acid deposition on watershed mass balances, and neutralization mechanisms and capacities were considered. Significant dry and wet fall out acid inputs were determined. Neutralization of incoming acid was sufficient to maintain relatively constant pH values in streams and lakes, but increased weathering and fluxes of calcium, magnesium, sodium, aluminum and trace metals out of the watershed were observed and low alkalinities indicated potential sensitivity to acid inputs. Ion exchange on clays appeared significant to neutralization, with evidence for both kinetic and equilibrium control of leaching. Sulfate adsorption was probably significant to cation mobility. Acid weathering of clays resulted in aluminum concentration increases in streams during storm events. Potential long-term adverse impacts of acid deposition were identified.
W83-03700

TOXIC EFFECTS OF NITRITE ON CHANNEL CATFISH,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
W. R. Garrett, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246934, Price codes: A04 in paper copy, A01 in microfiche. M. S. Thesis, Auburn University, AL, August 1983. 61 p, 10 Fig, 2 Tab, 93 Ref, 4 Append. OWRT A-079-ALA, 14-34-0001-2101.

Descriptors: Catfish, *Catfish ponds, *Nitrites, *Toxicity, *Water pollution effects, Fish, Catfish, Farming, Fish toxins, Lethal limit, *Channel catfish.

Channel catfish, Ictalurus punctatus, were exposed to acute and subacute concentrations of nitrite in flow-through toxicity tests. The 96-hour medium lethal concentration (LC50) and asymptotic LC50 for nitrite were 13.7 mg/l. Hematological and histological effects during subacute (10-day and 21-day) exposures were assessed. Methemoglobinemia was the most noticeable effect of subacute nitrite poisoning with methemoglobin levels increasing during an eight-hour exposure from 2.4 to 32.5% for 1 mg/l nitrite and from 2.8 to 68.4% for 5 mg/l nitrite. In fish exposed to 5 mg/l nitrite, hematocrit decreased after 14 days but then increased to control levels at 21 days. Changes in hematocrit may be related to degeneration of erythrocytes and a subsequent production of reticulocytes. No nitrite-related changes were observed in plasma chloride and plasma protein levels. Plasma glucose increased after 8 hours in fish exposed to 5 mg/l nitrite, then decreased after 72 hours. Plasma lactic acid increased significantly over controls after 72-96 hours. Plasma corticosteroid concentrations in fish exposed to 5 mg/l (10-day exposure) were significantly greater than in 1 mg/l exposed and control fish after 72 and 96 hours. Histological lesions were not observed after subacute exposure to nitrite. Glycogen-related vacuolation of hepatocytes decreased and was inversely correlated with methemoglobin concentrations in fish exposed to nitrite. Methemoglobinemia was the most consistent effect of nitrite exposure and would be more useful in determining that channel catfish had been exposed to nitrite than any of the other hematological or histological changes found in this study.
W83-03709

KINETICS OF PHOSPHORUS UPTAKE IN THE CHOWAN RIVER, NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W83-03711

THE EFFECTS OF BOTTOM WATER ANOXIA ON BENTHNIC NUTRIENT FLUX RATES IN THE PAMLICO RIVER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
S. E. Cabaniss.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246975, Price codes: A04 in paper copy, A01 in microfiche. M. S. Thesis, 1982. 62 p, 9 Fig, 4 Tab, 48 Ref, 1 Append. OWRT B-144-NC(2), 14-34-0001-1257.

Descriptors: *Bottom water, *Oxygen depletion, *Cycling nutrients, *Estuaies, Sediment-water interfaces, Interstial water, Nutrients, Phosphate, Ammonium, Rivers, Geochemistry, Benthic environment, *North Carolina, Pamlico River.

The benthic fluxes of phosphate and ammonium were determined in the Pamlico River, North Carolina, during the summer of 1981. Diffusive flux calculations from pore water concentration profiles and direct measurement of flux rates by in situ chamber incubations were compared and used to quantify the effect of bottom water anoxia on nutrient fluxes. Phosphate fluxes did not correlate with the phosphate concentration gradient at the sediment water interface. Ammonium fluxes correlated with the ammonium gradient and indicated the presence of a significant ammonium sink in the upper sediment. The average ammonium flux was over twofold higher during bottom water anoxia than before or after. Phosphate fluxes from sediment were very low before anoxia, exceptionally high at the onset of anoxia and moderately high during anoxia. Reversal of the flux direction was observed when oxygen returned to the bottom water as phosphate diffused into the sediment.
W83-03713

LEVELS OF NONPOLAR ORGANIC COMPOUNDS IN THE COLUMBIA GENERATING STATION COOLING POND,
Wisconsin Univ.-Madison. Dept. of Water Chemistry.
A. W. Andren, and R. Erickson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249581, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center Publication No WIS WRC 83-08, 1983. 13 p, 1 Fig, 4 Tab, 5 Ref. OWRT A-090-WIS(1), 14-34-0001-0153.

Descriptors: *Cooling ponds, *Hydrocarbons, *Organic compounds, *Powerplants, Chlorinated hydrocarbons, Coal, Electric powerplants, Fish, Sediments, *Wisconsin, Portage.

In 1970, plans to build a coal-fired generating station near Portage, Wisconsin and an interest by involved utilities in carrying out a preconstruction analysis of potential environmental changes created a unique opportunity for broadly based research on the impacts of coal-fired steam plants. Of particular concern to aquatic scientists are the potential problems associated with the 192-ha manmade cooling pond. The research presented in this report describes a survey of the types and levels of nonpolar xenobiotic organic compounds in sediments and fish from the cooling pond. Sediment and fish samples were analyzed for PCBs, sum DDT, and hexachlorobenzene using techniques developed at the Water Chemistry Laboratory, University of Wisconsin-Madison. It was hypothesized that polyaromatic hydrocarbons and chlorinated hydrocarbons would accumulate; however, results indicate that the microcontaminants do not concentrate in the cooling pond. Reasons for why there is no microcontaminant problem are presented.
W83-03717

EFFECT OF SIMULATED ACID PRECIPITATION ON ALGAL FIXATION OF NITROGEN AND CARBON DIOXIDE IN FOREST SOILS,
Cornell Univ., Ithaca, NY. Lab. of Soil Microbiology.
F-H. Chang, and M. Alexander.
Environmental Science and Technology, Vol 17, No 1, p 11-13, January, 1983. 2 Tab, 13 Ref.

Descriptors: *Acid rain, *Algae, *Nitrogen fixation, Water pollution effects, Forest soils, Carbon

dioxide, Toxicity, *New York, Watersheds, Adirondacks region.

Indigenous algae growing in soil samples from the Panther, Woods, and Sagamore Lake watersheds of the Adirondacks regions of New York were exposed to acid precipitation of pH 3.5 or 5.6 at rates of 50, 100, 200, and 300 cm. Rates of nitrogen fixation as measured by acetylene reduction were significantly less for soils watered with pH 3.5 water compared with the pH 5.6 water for all rainfall intensities, for light and dark, and for all soils. As rain volume increased, acetylene reduction decreased for the 3.5 pH water and increased for the 5.6 pH water. Carbon dioxide fixation rate was significantly less for all soils exposed to the more acid rain, and the extent of inhibition became more pronounced with increasing volumes of rain applied. (Cassar-FRC)
W83-03797

5D. Waste Treatment Processes

THE BIODEGRADATION OF BIS (TRIBUTYLTIN) OXIDE (TBTO) BY BILOGICAL SEWAGE TREATMENT (DER BIOLOGISCHE ABBAU VON TRIBUTYLZINNOXID (TBTO) IN EINER BELEBTSCHLAMMANLAGE),
T. Stein, and K. Kuster.
Zeitschrift fuer Wasser-und Abwasser Forschung, Vol 15, No 4, p 178-180, August, 1982. 1 Tab, 7 Ref.

Descriptors: *Biological wastewater treatment, *Organotin compounds, Bis(tributyltin) oxide, Bacteria, Microorganisms, *Wastewater treatment, Municipal wastewater, Industrial wastes, Water pollution control.

The biodegradation of bis(tributyltin) oxide was studied in relation to continuing emphasis on the influence of tributyltin compounds on microorganisms of the biological sewage treatment plant. It was demonstrated that at a TBTO concentration of 2 mg/liter the biodegradation to inorganic tin compounds is more than 87%. An essential condition to reach this level of degradation is a long adaptation phase of the biological system to the organotin compounds. (Baker-FRC)
W83-03506

POLLUTION OF THE MEDITERRANEAN COASTAL AREA (LA POLLUTION DU LITTORAL DE LA MEDITERRANEE),
R. Ringuelet.
Progress in Water Technology, Vol 12, No 4, p 695-722, 1980. 6 Fig, 6 Tab.

Descriptors: *Stabilization ponds, *Stabilization lagoons, *Coastal waters, *Seasonal variation, *Wastewater treatment, Design criteria, Coastal zone management, Water pollution control, Biochemical oxygen demand, Municipal wastes, Bacteria, *Mediterranean Sea, *France.

The natural stabilization pond or lagoon is well suited as a treatment method for the coastal areas of the Mediterranean which experience seasonal demands. In Languedoc, this type of treatment has been studied for 15 years and quantified over the past 5 years. Design parameters are presented. The water depth should be 1.2 m in the first lagoon and 1 m in subsequent lagoons. The normal maximum loading is 75 kg BOD/hectare/day, with a short midsummer peak period of 100-120 kg BOD/day. The detention period is 30 to 50 days. One hectare is necessary for the removal of bacteria from sewage for a population of 2000 persons in winter and 3000 persons in summer. (Small-FRC)
W83-03509

PREFERRED SOLUTIONS AND DEVELOPMENT TRENDS FOR WASTEWATER CONVEYANCE IN DRAINAGE NETWORKS (VORZUGSLOSUNGEN UND ENTWICKLUNGSTENDENZEN DER ABWASSERFORDERUNG IN ENTWASSERUNGSNETZEN),
VEB Projektierung Wasserwirtschaft, Halle (German D.R.)
P. Richardt
Wasserwirtschaft-Wassertechnik, Vol 32, No 7, p 227-229, July, 1982. 5 Fig, 3 Tab, 1 Ref. (No English Summary).

Descriptors: Hydraulic engineering, *Wastewater collection, *Drainage systems, *Detritus, *Pumps, Solid wastes, *German Democratic Republic, Construction costs, Design criteria, Hydraulic design, Hydraulic equipment, Sieves, Water conveyance, *Conveyance structures.

The current preferred practice for the conveyance of wastewater in the German Democratic Republic is to transport solid debris together with the wastewater into the pressure pipe network and to remove debris from the wastewater at the treatment plant. However, pumping gear now in use is equipped to fulfill this requirement only up to a maximal volume flow of 2,000 cu m/hr; above this level, debris must be removed by grids at the pumping station. Preferred methods of conveying debris with wastewater include the sieve reservoir pump, pumping stations with wastewater immersion pumps, and prechamber pumps. With the sieve reservoir pump, debris is held back by a sieve in a steel tank that is divided by the sieve into a preliminary purification area and a wastewater collection area. Wastewater is then transported from the later in the opposite direction from the inflow back to the sieve, and from there, both wastewater and debris are fed into the pressure pipe. Wastewater immersion pumps reduce construction costs, space and time. The prechamber pump consists of an underground section divided into prechamber, wastewater collection area, and pump room and an above-ground section that has now been reduced by about 60% compared to the area previously required. Prechamber and collection area are divided by a grid that is inclined against the inflow direction so that debris is retained in the prechamber. The present trend of development is to reduce construction and thereby construction time by measures including compact installation of advanced technological equipment. (Gish-FRC)
W83-03517

STUDIES ON THE SOIL APPLICATION TREATMENT OF COKING PLANT WASTEWATER (UNTERSUCHUNGEN ZUR BODENBEHANDLUNG VON KOKEREIABWASSER),
Institut fuer Wasserwirtschaft, Berlin (Germany, F.R.).
F. Schulz, D. Steyer, and W. Kruger.
Wasserwirtschaft-Wassertechnik, Vol 32, No 7, p 233-235, July, 1982. 1 Fig, 5 Tab, 9 Ref. (No English Summary).

Descriptors: *Advanced wastewater treatment, *Soil treatment, *Mine wastes, *Wastewater irrigation, *Lysimeters, Wastewater disposal, Wastewater treatment, Percolation, Groundwater, Land disposal, Nitrogen, Potassium, Organic acids, Phenols, Organic acids, Phenols, Organic compounds, Water quality.

Advanced treatment of wastewater from the brown-coal thermal processing industry by passing the water through soil allows multiple use of the water with nitrogen reclamation. Lysimete studies were conducted on enriched soil formed from mining wastes and treated in this way. In similar untreated soil, 11-23% of natural precipation (mean 15%) percolated through the soil over a three-year period, while for soil sprinkled with wastewater, 38-61% (mean 46%) of natural precipitation plus added wastewater percolated. Mining-waste soil is characterized by high volatile organic acids and other chemically oxidizable organic matter (COOM) and by the presence of inorganic acids and potassium showed levels many times higher than those in untreated soil, whereas levels for COOM and inorganic nitrogen were only 62 and 85% higher, respectively, in treated soil. The lysimeter measurements showed that the purification efficacy of this wastewater treatment method was 100% for phenol compounds, a mean of 93% for COOM, 74% for volatile organic acids, and 89% for inorganic nitrogen. Groundwater quality > 20 m below the mining waste soil was also studied: phenol compounds were not found; volatile organic acids were found in high and variable amounts, but were not related to wastewater application; COOM levels were also variable, and although they were higher within the treated area, were not directly attributable to wastewater application; potassium and nitrogen levels were unrelated to wastewater application. This three-year treatment program allowed 3.3 million cu m wastewater containing 380 ton phenols, 2,770 ton volatile organic acids, and 595 ton NH4-N to be held back from the receiving stream. (Gish-FRC)
W83-03519

ECONOMICAL WATER USE AND RECOVERY OF VALUABLE MATERIALS BY MEANS OF ION EXCHANGERS IN THE SURFACE FINISHING INDUSTRY (WIRTSCHAFTLICHE WASSERVERWENDUNG UND WERTSTOFFRUCKGEWINNUNG DURCH IONENAUSTAUSCHER IN DER OBERFLACHENVEREDELNDEN INDUSTRIE),
For primary bibliographic entry see Field 3E.
W83-03521

HYDROCARBON REMOVAL IN A THREE-PHASE FLUIDIZED EXPERIMENTAL BED AND MODELLING OF THE PROCESS (EPURATION HYDROCARBONNE EN COUCHE FLUIDISEE TRIPHASIQUE ETUDE EXPERIMENTALE ET MODELISATION),
Montpellier-2 Univ. (France). Lab. de Genie Chimique, Traitment et Epuration des Eaux.
A. Grasmick, B. Chatib, S. Elmaleh, and R. Ben Aim.
Water Research, Vol 15, No 6, p 719-727, June, 1981. 8 Fig, 8 Tab, 11 Ref.

Descriptors: *Fluidized beds, *Fluidized bed process, *Model studies, *Mathematical models, *Wastewater treatment, Hydrocarbons, Turbulent flow, Aeration, Biological wastewater treatment, Biological oxygen demand, Mass transfer, France.

A 9.4 cm three-phase fluidized bed reactor was evaluated, and a model based on previous work on fixed-bed reactors is proposed. In the new reactor, turbulence induced by air injection should remove excess biomass and avoid bed clogging. With step injections of synthetic sewage for different values of working parameters, the reactor had an elimination efficiency of 10 kg BOD5/cu m/day without recycle. Limitations of the three-phase fluidized reactor were insufficient oxygen transfer to the liquid phase due to rapid bubble coalescence; and inefficient sloughing, which allows the reactor to be segregated depending on biofilm thickness. In the model, interphase mass transfer and zero order reaction within the biofilm are taken into account, and it is assumed that the liquid phase is perfectly mixed. The model's two parameters are a combination of the numbers of transfer units within the biofilm and through the boundary layer and of the number of reaction units in the biofilm. Oxygen, organic carbon, or any other nutrient may be the limiting substrate. The model predicts experimental efficiencies with an accuracy of 15%. (Small-FRC)
W83-03531

THE ADSORPTION OF BOVINE SERUM ALBUMIN BY ACTIVATED SLUDGE,
University Coll., Dublin (Ireland).Dept. of Industrial Microbiology.
M. B. Crombie-Quilty, and A. J. McLoughlin.
Water Research, Vol 17, No 1, p 39-45, January, 1983. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Activated sludge process, *Adsorption, *Colloids, *Wastewater treatment, *Albumin, Kinetics, Biomass, Activated sludge adsorption equation.

Bovine serum albumin (BSA) was rapidly removed by BSA-acclimated activated sludge via adsorption. The extent of adsorption (2-42%) varied with the substrate: biomass ratio. The concentration of BSA adsorbed was influenced by both the concentration of BSA and the concentration of activated sludge. The experimental data did not conform to Langmuir or Freundlich equations, but fit the newly developed activated sludge adsorption equa-

tion proposed by Banerji et al. (1968). The concentration of BSA adsorbed per unit weight activated sludge and the concentration of BSA in equilibrium per unit weight activated sludge were expressed as functions of the concentration of BSA added to the system per unit weight adsorbent. This related adsorption to the substrate: biomass ratio. (Cassar-FRC)
W83-03533

A DYNAMIC MODEL OF THE HIGH-RATE ALGAL-BACTERIAL WASTEWATER TREATMENT POND,
Cape Town Univ. (South Africa). Dept. of Chemical Engineering.
H. O. Buhr, and S. B. Miller.
Water Research, Vol 17, No 1, p 29-37, January, 1983. 6 Fig, 2 Tab, 30 Ref.

Descriptors: *Algae, *Bacteria, *Ponds, *Wastewater treatment, Model studies, Oxidation ponds, Algal growth, Diurnal variation.

The symbiotic growth of algae and bacteria in a high-rate wastewater treatment pond was described by a mathematical model, which included components for algal growth, light limitation, aerobic bacterial growth, solution equilibria, and material balances. Simulated results agreed with experimental results reported by Dors in 1974. Operating parameters (pH, dissolved oxygen, and substrate concentration) changed in a diurnal pattern and along the length of the race-track shaped channel. An equation calculated an appropriate circulation rate for maintaining turbulent flow and adequate mixing. Temperature was important in determining the feed residence time. A curve presented the algal yield vs. hydraulic residence time for ponds of 300, 400, and 500 mm depth and temperatures of 10, 20, and 30C. (Cassar-FRC)
W83-03534

TESTS ON AERATORS: CONCLUSIONS DRAWN FROM 500 CLEAN WATER TESTS CONDUCTED IN 200 DIFFERENT SEWAGE TREATMENT PLANTS - I TEST PROCEDURE (ESSAIS D'AERATEURS ENSEIGNEMENTS TIRES DE 500 ESSAIS EN EU CLAIR EFFECTUES DANS 200 STATIONS D'EPURATION DIFFERENTES - I METHODOLOGIE),
Centre National de Machinisme Agricole du Genie Rural, des Eaux et des Forets, Paris (France).
A. Heduit, and Y. Racault.
Water Research, Vol 17, No 1, p 97-103, January, 1983. 2 Fig, 7 Tab, 16 Ref. English abstract.

Descriptors: *Wastewater treatment facilities, *Testing procedures, *Aerators, *Wasterwater treatment, Oxidation, Aeration, Dissolved oxygen, Sampling, Sulfite.

Aeration represents the main part of energy consumption in the activated sludge process, and the evaluation of aeration systems' efficiency is becoming more important as energy costs increase. All of the present tests were conducted using tap water under non-steady-state conditions. The initial dissolved oxygen level is brought down to zero by adding cobalt chloride as catalyst and sodium sulfite. When all of the sodium sulfite has been consumed, the increase in water dissolved oxygen content is monitored vs time at various locations in the tank by means of membrane probes. In tests on water quality parameters it appeared that only the presence of surfactants, flocculated suspended solids, or high salinity are liable to have any appreciable effect on oxygen transfer. The unflocculated SS, pH and alkalinity have no effect on oxygenation results in the common range of values occurring in the tests. Recommendations are given for the application of specific tests to sewage treatment plants. (Baker-FRC)
W83-03535

DISPERSION IN THE INCLINED PLANE MODEL OF TRICKLING FILTERS,
Technical Univ. of Istanbul (Turkey). Dept. of Environmental Engineering.
Y. Muslu.
Water Research, Vol 17, No. 1, p 105-115, January, 1983. 7 Fig, 7 Tab, 13 Ref.

Descriptors: *Trickling filters, *Dispersion, *Mathematical equations, Hydraulics, Filtration, *Wastewater treatment, Flow, Model studies.

An attempt is made to establish a relationship between the removal efficiency and the hydraulic regimes of biological filters. For this purpose an equation was first derived to determine the dispersion number. Using this equation, effluent concentration was calculated by means of dispersed plug flow models in the range of channelized flow and for large hydraulic loadings. Around the minimum wetting rate, the removal efficiencies are computed with equations of complete mixing. The application of this theory to the experimental results reported in the literature has been shown, and the ranges of validity of dispersed plug flows and mix flows are determined. It is also demonstrated that the predicted concentrations are in good agreement with the measured values. At large flow rates the dispersed plug flow model gave good results. Between the mixed and dispersed flow zones defined by the limits given there are transition regions corresponding to other mixing conditions. Increasing concentrations tend to decrease removal somewhat, particularly in the range of low applied loading. However, it can be concluded that concentration has the least effect on removal efficiency when compared with other factors. For BOD5 concentrations less than 200 mg/liter the equation expressing the first order kinetic relationship is a reasonable approximation for low rate trickling filters, as the dispersion numbers are small. (Baker-FRC)
W83-03537

THE BIODEGRADATION OF N-METHYL-2-PYRROLIDONE IN WATER BY SEWAGE BACTERIA,
Department of Scientific Services, Singapore.
S. T. Chow, and T. L. Ng.
Water Research, Vol 17, No 1, p 117-118, January, 1983. 6 Ref.

Descriptors: *Wastewater treatment, *Bacteria, *Biodegradation, N-Methyl-2-pyrrolidone, Sewage bacteria, Oxygen demand, Metabolites.

The biodegradability of N-methyl-2-pyrrolidone was studied using a static die-away system and a semi-continuous activated sludge system. The NMP concentrations of the filtered supernatant culture mixture were determined by gas-liquid chromatography using menthol as internal standard. On the PEG 20M column, menthol and NMP haveretention times of 9.5 and 11.5 min, respectively. No peak was noted in a culture solution which has not been dosed with NMP but which contained all the other ingredients required for the biodegradation test. Results of the die-away test showed that NMP is readily biodegradable in a static system. A value of 95% biodegradability was obtained after a 2 week period of incubation. With the semi-continuous activated sludge test, after 5 days of incremental acclimatin to 100 ppm of NMP, a 7-day average biodegradability of 95% was obtained. The tests indicated that NMP did not break down to carbon dioxide and water under these conditions. The metabolite has an appreciable oxygen demand, which is about half that of NMP. To study the metabolite further the culture mixture from the static die-away test was extracted with chloroform and analyzed by infrared spectroscopy. Results indicated that in the biodegradation of NMP, the C-N bond between the nitrogen atom and the carbonyl group was cleaved. (Baker-FRC)
W83-03538

INNOVATIVE TECHNOLOGY RECYCLES WASTE.
Hirsch and Co., San Diego, CA.
World Dredging and Marine Construction, Vol 18, No 12, p 9-13, December, 1982. 5 Fig.

Descriptors: *Wastewater treatment, *Water recycling, *Water reuse, *Aquaculture, Hyacinths, Plants, San Diego, *California, Bacteria, Snails, Catfish, Crayfish, Drinking water, Water supply development.

The San Diego Water Utilities Aquaculture Project takes 25,000 gallons of raw sewage a day, filters it, lets water hyacinths absorb the unwanted nitrate-phosphate nutrients in sewage, filters it again and adds reverse osmosis, a process that draws remaining impurities out of the solution, with the end product being clear and potable water. In a man-made swamp biosphere the hyacinths work with crayfish, catfish and snails living on the bottom of a four feet deep tank to take 99% of the bacteria out of the water. Reverse osmosis removes nearly all the remaining bacteria and salts, and a final cleanup is made with carbon absorption and a disinfectant, such as chlorine or ozone. The recycled water is used to grow replacement sod on the home turf of San Diego's major sports stadium. The water hyacinths grown on the wastewater nutrients are converted to fertilizer, methane gas, and animal fodder. The goals of the program were to prove that there is a better way to treat sewage, that pure drinking quality water can be produced, and that animal fodder and energy are valuable spin-off products. (Baker-FRC)
W83-03545

MICROPOLLUTANTS PRODUCED BY DISINFECTION OF WASTEWATER EFFLUENTS,
Oak Ridge National Lab., TN.
R. L. Jolley, R. B. Cumming, N. E. Lee, J. E. Thompson, and L. R. Lewis.
Water Science and Technology, Vol 14, No 12, p 45-49, 1982. 1 Fig, 2 Tab, 17 Ref.

Descriptors: *Wastewater treatment, *Micropollutants, Water pollution sources, Mutagens, Organic compounds, Ozonation, Chlorination, *Disinfection, Chlorine, Ozone.

The effects of disinfection by chlorine, ozone, and ultraviolet light irradiation were examined on nonvolatile organic constituents relative to chemical effects and the formation of micropollutants. Disinfection with chlorine or ozone both destroys and produces nonvolatile organic constituents, including mutagenic constituents. The chemical effects of disinfection by UV irradiation were relatively slight, although the mutagenic constituents in one effluent were eliminated by this treatment. Nine wastewater treatment plants were selected for study. Grab sample collection was carried out on undisinfected and disinfected effluents. Over 100 micropollutants were identified in the wastewater effluent concentrates which were prepared from the grab samples. Considerable variability was noted in the presence of mutagenic nonvolatile organic constituents in the undisinfected effluent concentrates, as well as much variability in the destruction of the mutagenic constituents and the formation of other mutagenic constituents as a result of disinfection. No micropollutants known to be mutagens were identified in the mutagenic HPLC fractions separated from the undisinfected, chlorinated, and ozonated effluent concentrates. The mutagenic activity of the nonvolatile organic constituents in one chlorinated effluent concentrate was not attributable to organic chloramines. Most of the mutagens detected in effluent concentrates are direct acting and do not require metabolic activation. (Baker-FRC)
W83-03546

ELIMINATION OF ORGANIC MICROPOLLUTANTS,
Swedish Water and Waste Water Works Association, Stockholm.
B. Hultman.
Water Science and Technology, Vol 14, No 12, 73-86, 1982. 9 Tab, 63 Ref.

Descriptors: *Wastewater treatment, *Organic compounds, *Nitrosamines, Activated carbon, Adsorption, Stripping, Ozone, Oxidation, Biological degradation, Solubility, Volatility.

The elimination of organic micropollutants from water and wastewater may be done by separation methods, which are useful to concentrate and relocate pollutants so that they can be more readily recovered or destroyed, or by destruction and detoxification methods, in which the pollutants are destroyed and detoxified by the use of oxidation or reduction. Both of these principal methods are

discussed, with particular emphasis on similarities between treatment techniques, prediction methods of removal efficiencies and treatment of priority pollutants. It was concluded that if separation methods are used, it is important to consider the handling of the phase in which the micropollutant has been concentrated. During certain treatment processes micropollutants are formed. Of special interest is the formation of chlorinated organic compounds and nitrosamines. The processes for eliminating organic micropollutants include stripping by air and steam, ozone oxidation, activated carbon adsorption and biological degradation. Oxidation agents may be used for total oxidation of the organic material or for rendering the organic material biodegradable. The fugacity, related such to properties as solubility, volatility, octanol-water partitioning coefficient, and others, may be used to predict the removal efficiency of organic micropollutants in such processes as stripping and carbon adsorption in biological sludges. The combined use of oxidizing agents and flocculants may be suitable for conditioning of sludges and may partly reduce the sludge levels of organic micropollutants. (Baker-FRC)
W83-03547

BATCH FLOTATION TESTS: HOW USEFUL ARE THEY.,
J. Bratby.
Journal of the Water Pollution Control Federation, Vol 55, No 1, p 110-113, January, 1983. 23 Ref.

Descriptors: *Testing procedures, *Flotation, *Separation techniques, Mechanical equipment, Suspended solids, Solids, Clarification, *Wastewater treatment.

The scope and validity of batch tests applied to flotation are considered. A testing program designed to gather information on the clarification aspect of flotation would determine the relationship between the limiting downflow rate and the air/solids ratio. Procedures for obtaining such information with continuous-type tests have been outlined. The procedure with batch tests is to introduce the air-contacted wastewater feed to a flotation column that is usually 250 to 500 mm high and to carry out what amounts to an inverted settling test. At an air/solids ratio of 0.01, batch predicted effective rise rates would be greater by a factor of about 2.5 times the actual value; at an air/solids ratio of 0.025, the predicted value would be greater by a factor of about 1.4 times the actual value. The poor correlation between batch and continuous results for flotation clarification makes design data based on batch test results highly suspect. At the outset, batch flotation tests are particularly inappropriate for predicting thickening performance. It is virtually impossible to duplicate in-plant conditions. It is essential to optimize thickening design on the basis of solids loading rate and height of float above the water level. The air/solids ratio will be assigned a value based on the downflow rate and the total depth of float solids, and the scraper will be designed on the basis of removing float solids concentration and solids loading rate. (Baker-FRC)
W83-03549

BIOLOGICAL TREATABILITY OF SPECIFIC ORGANIC COMPOUNDS FOUND IN CHEMICAL INDUSTRY WASTEWATERS,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
E. L. Stover, and D. F. Kincannon.
Journal of the Water Pollution Control Federation, Vol 55, No 1, p 97-109, January, 1983. 6 Fig, 9 Tab, 9 Ref.

Descriptors: *Wastewater treatment, Fate of pollutants, Pollutant identification, Model studies, *Organic compounds, Chemical reactions, *Biodegradation.

Development of a data base on the treatability and fate of specific organic compounds during biological treatment was initiated. The possibility of future limitations on specific compounds requires the capability to predict treatability and the fate of the compounds in question during treatment. Studies were conducted on the impacts on biodegradation of phenomena such as stripping and adsorption depending on the physical and chemical characteristics of specific compounds. The impacts of stripping on biokinetic constants have been shown for a variety of compounds, and means for analysis of these impacts was proposed through modification of the existing predictive models. The study combined selected organic compounds with a base mix that was readily biodegradable. The compounds were added individually and in groups to simulate real wastewaters. The biological systems were operated at three different sludge ages for each wastewater and monitored to develop the data needed for determining the biological kinetic constants. Each individual system was analyzed in terms of BOD, COD, TOC and the specific organic pollutants added. The fate of each specific compound during treatment was also determined. (Baker-FRC)
W83-03550

ENTEROCOCCI AND OTHER MICROBIAL INDICATORS IN MUNICIPAL WASTEWATER EFFLUENTS,
Food and Drug Administration, Davisville, RI. Shellfish Sanitation Branch.
For primary bibliographic entry see Field 5A.
W83-03551

THE ELIMINATION OF MINERAL MICROPOLLUTANTS,
Compagnie Intercommunale Bruxelloise des Eaux (Belgium).
B. Regnier, C. Goblet, J. Genot, and W. J. Masschelein.
Water Science and Technology, Vol 14, No 12, p 87-105, 1982. 6 Fig, 17 Tab, 19 Ref.

Descriptors: *Minerals, *Wastewater treatment, *Water treatment, Drinking water, *Water treatment, Oxidation, Alkalinity, Precipitation, Acidity, Ion exchange, Resins, Carbon, Adsorption, Nickel, Iron, Manganese, Sludge, Chromium, Colbalt, Cadmium, Lead.

Mineral micropollutants in waste waters and drinking waters are essentially composed of heavy metal salts. Their elimination when present in trace quantities is reviewed. The techniques available necessitate preclarification in open basins and elimination by filtration, with efficiencies depending largely on preoxidation but particularly on coagulation-precipitation and related techniques. The predominant importance of contact between water and sludges in decanters/clarificators is vital. The oxidation state of metals plays an important role in techniques for their elimination by the usual methods such as coagulation-flocculation-decantation, as well as in coprecipitation phenomena of Fe and Mn, for example. The method of alkaline precipitation, in which the pH value needed is obtained by addition of lime, results in elimination rates over 80% and generally far over 90%. This method simultaneously uses direct precipitation and coprecipitation in a calcium carbonate/magnesium oxide matrix. Ion exchange gives highly variable elimination results according to the ion present and its concentration. In practice, strong cation exchange resins are generally applied. In treatment plants adsorption on carbon allows an overall yield of 50-100% removal of the metal concerned, provided that preoxidation and sufficient contact times are allowed. Of the remaining traces, 30-50% are removed by infiltration of purified waters underground, where a levelling of concentrations also occurs. (Baker-FRC)
W83-03556

MEASUREMENT AND VALIDITY OF OXYGEN UPTAKE AS AN ACTIVATED SLUDGE PROCESS CONTROL PARAMETER,
Pirnie (Malcolm), Inc., Newport News, VA.
G. L. Edwards, and J. H. Sherrard.
Journal of the Water Pollution Control Federation, Vol 54, No 12, p 1546-1552, December, 1982. 20 Fig, 15 Ref.

Descriptors: *Activated sludge process, *Oxygen uptake, Aeration basins, Biochemical oxygen demand, Chemical oxygen demand, *Wastewater treatment, Oxygen demand, Flow, Water Quality, Virginia, Blacksburg.

The question was considered of whether or not specific oxygen uptake rate is a meaningful control parameter for the activated sludge process. Five different 24 hr studies were conducted at the Blacksburg and Virginia Polytechnic Institute Treatment Plant to study the effects of variable influent organic and hydraulic loadings on the specific oxygen uptake rate in the aeration basins and the corresponding effects on effluent quality. Results from 3 of the test periods are discussed. Based on these studies the following conclusions are drawn: a change in specific oxygen uptake rate for a wastewater of highly variable influent flow and organic loadings does not necessarily produce a significant change in effluent quality as measured by BOD and COD. Specific oxygen uptake rate cannot be used as a control parameter for the activated sludge process when treating a highly variable influent quantity and quality flow. (Baker-FRC)
W83-03569

DETERMINATION OF BIOMASS MLVSS IN PACT SLUDGES,
Akron Univ., OH. Dept. of Civil Engineering.
W. B. Arbuckle, and A. A. Griggs.
Journal of the Water Pollution Control Federation, Vol 54, No 12, p 1553-1557, December, 1982. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Activated carbon, Volatility, Suspended solids, Water quality, Carbon, Powdered activated carbon treatment.

The Powdered Activated Carbon Treatment (PACT) process is basically a conventional activated sludge plant to which powdered activated carbon is added. The carbon is slurried and fed with the waste stream, which then flows into an aeration basin. During aeration, wastes are simultaneously adsorbed onto the carbon and biologically degraded. The mixture then goes to a clarifier, where the carbon and biomass settle for recycling to the aerator. The resultant effluent is consistently of higher quality than would be obtained from activated sludge alone. The waste sludge produced may be handled by conventional means or may be regenerated to recover activated carbon for reuse in the process. The concentration of PAC in the mixed liquor is an important new parameter. Six combinations of PAC and biomass were evaluated at six temperatures to determine volatility. Volatility increased with increasing temperature for all sludges except for 100% PAC, which had a constant fraction volatilized at temperatures less than 400C. The average error for five different combinations was 4.4%, with most of the error due to one sludge which contained 16.7% PAC. Results appear least accurate when PAC is 10 to 20% of the total sludge. (Baker-FRC)
W83-03570

DISCUSSION OF: EFFECT OF A BACTERIAL CULTURE PRODUCT ON BIOLOGICAL KINETICS,
Flow Labs., Inc., Inglewood, CA. Envirnmental Cultures Div.
R. B. Grubbs, T. G. Zitrides, C. S. McDowell, J. N. Zikopoulos, and L. M. Johnson.
Journal of the Water Pollution Control Federation, Vol 54, No 12, p 1614-1616, December, 1982.

Descriptors: *Bacteria, *Cultures, *Kinetics, Wastewater treatment, *Biological treatment.

The above titled paper by S. R. Qasim and M. L. Stinehelfer, Journal of the Water Pollution Control Federation, Volume 54, page 255, 1982, was criticized for several of its conclusions, based on laboratory tests of a biological wastewater treatment system. The author of the first comment questions the old references used, the disregard of scale effects in extrapolating results from laboratory to field, the selection of the bacterial culture used, and the composition of the experimental

wastewater. Authors of the second comment point out deficiencies in the following: data collection, experimental simulation of dynamic factors affecting all full-scale wastewater treatment plants, discussion of important trends in experimental data, description of test conditions, and support for conclusions. The authors of the original paper reply that their paper's intent was to present a methodology for evaluating bacterial culture products. (Cassar-FRC)
W83-03571

USE OF HYDROCYCLONES TO TREAT SEAFOOD-PROCESSING WASTEWATERS,
Alaska Univ., Fairbanks. Dept. of Engineering.
R. A. Johnson, and K. L. Lindley.
Journal of the Water Pollution Control Federation, Vol 54, No 12, p 1607-1612, December, 1982. 4 Fig, 1 Tab, 20 Ref.

Descriptors: *Food-processing wastes, *Industrial wastewater, *Cyclones, *Wastewater treatment, Seafood-processing wastes, Shellfish, Fish, Suspended solids, *Hydrocyclones, Alaska, Canneries, Particulate matter, Economic feasibility.

Hydrocyclones were used to collect particulate matter from seafood processing wastewaters in both laboratory and pilot scale studies. Laboratory cyclones of 25 to 75 mm diameter produced removal efficiencies of 68-92% (concentration factors of 2-8) using plant effluents containing king crab shell, shrimp waste, and salmon waste. The pilot wastewater treatment plant contained two 75 mm cyclones and a 25 mm cyclone. Pilot plant efficiencies were 69-86% and concentration factors, 5-18, depending on the number of cyclones used in the run and the type of waste (Tanner crab, shrimp, or salmon). Total suspended (kg per 1000 kg raw product) in the pilot scale cyclone effluents averaged 2 for crab wastewater, 5.7 for salmon wastewater, and 3.7 for shrimp wastewater. The low capital and operating costs associated with cyclones are well within the range of economic feasibility. In addition, the recovery of fish and shellfish meal can offset some of the treatment costs. (Cassar-FRC)
W83-03572

DISCUSSION OF: AMMONIA NITROGEN REMOVAL IN FACULTATIVE WASTEWATER STABILIZATION PONDS AND NITROGEN DYNAMICS IN WASTE STABILIZATION PONDS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
F. A. DiGiano, E. J. Middlebrooks, and R. A. Ferrara.
Journal of the Water Pollution Control Federation, Vol 54, No 12, p 1617-1618, December, 1982. 2 Fig, 1 Ref.

Descriptors: *Nitrogen removal, *Stabilization ponds, *Wastewater lagoons, *Wastewater treatment, Ammonia, Volatilization, Algae, Lagoons.

Two papers on the subject, mechanisms of nitrogen removal from wastewater stabilization ponds, used data collected from similar ponds but reached different conclusions. A. Pano and E. J. Middlebrooks (Journal of the Water Pollution Control Federation, Volume 54, page 344, 1982) attributed nitrogen removal to ammonia volatilization. R. A. Ferrara and C. B. Avci (same journal, Volume 54, page 361, 1982) stated that volatilization was not responsible for nitrogen removal because algal uptake removes ammonia-N. The writer of the criticism disagreed with some of the equations used by Pano and Middlebrooks, who in turn claimed that DiGiano's equations were incorrect. Ferrara claimed that ammonia volatilization is not the correct removal mechanism because this conclusion was based on the assumption that a steady-state condition existed, when, in fact, this was not the case in the pond studied. Ferrara used a time-variable approach to assess the relative magnitude of the mass transfer mechanisms for nitrogen in stabilization ponds. (Cassar-FRC)
W83-03573

FILTRATION OF PRIMARY EFFLUENT,
California Univ., Davis. Dept. of Civil Engineering.
M. R. Matsumoto, T. M. Galeziewski, G. Tchobanoglous, and D. S. Ross.
Journal of the Water Pollution Control Federation, Vol 54, No 12, p 1581-1591, December, 1982. 6 Fig, 4 Tab, 7 Ref.

Descriptors: *Filtration, *Wastewater treatment, *Biochemical oxygen demand, Oxygen demand, Effluents, Water quality, *Suspended solids, Pulsed-bed filters, *Filters.

The results of pilot designed to evaluate the feasibility of primary effluent filtration are presented. The objectives of the pilot studies were to determine the effectiveness of pulsed-bed filtration in reducing the suspended solids (SS) and biochemical oxygen demand of primary effluent, to determine the effects of using various sand sizes on the filtrate quality and filter run length, to determine the effects of varying hydraulic loading rates on the filtrate quality and filter run length, and to determine the long term performance of filters used for primary effluent filtration. The filtration of primary effluent with the pulsed bed filter appeared technically feasible. The SS removal efficiency for the filtration of primary effluent was a function of filter medium size and filtration rate. Above a sand size of 0.45 mm, filter performance was primarily a function of the filtration rate. The removal of BOD and SS were slightly related. A linear correlation was noted between these two parameters. The majority of BOD removed during the filtration of primary effluent was associated with the particulate BOD of the solids. The use of a chemical cleaning cycle is essential for successful long term filtration of primary effluent. Because the solids in backwash return water flocculate and settle rapidly, recycling of backwash water to the primary clarifer may be eliminated by using a small settling tank to separate the solids in the backwash water. The ability to filter primary effluent opens up many new possibilities for the treatment of wastewater. (Baker-FRC)
W83-03574

TREATMENT OF RAW WASTEWATER OVERFLOWS BY DISSOLVED-AIR FLOTATION,
Servicos de Engenharia Emilio Baumgart Ltd., Belo Horizonte (Brazil).
J. R. Bratby.
Journal of the Water Pollution Control Federation, Vol 54, No 12, p 1558-1565, December, 1982. 9 Fig, 1 Tab, 27 Ref.

Descriptors: *Wastewater treatment, *Dissolved air flotation, *Flotation, Water treatment, Seasonal variation, Design criteria, Wastewater treatment facilities, Brazil.

Treatment of raw wastewater excess flows by physical-chemical means is proposed, using dissolved air flotation for solid-liquid separation. Alum is the most appropriate coagulant for the present application. At a dose of 80 mg/l and a pH of 5.5, the efficiencies of removal of suspended solids, chemical oxygen demand, and phosphorus during flotation are 97, 84, and 92%, respectively. No flocculation is needed for efficient flotation. The minimum practicable air/solids ratio is 0.09. Within certain limits, the saturator pressure applied is immaterial, provided a given ratio of air to solids is maintained. Float solids concentrations of at least 8.3% are attainable by flotation; using lime to condition float solids, filter press concentrations of up to 40% are possible. Pilot plant filter press studies have shown that cake concentrations of 17% are attainable with float solids without conditioning. With conditioning, cake concentrations of 22% are attainable using polyelectrolyte. (Baker-FRC)
W83-03575

DISCUSSION OF: INDUSTRIAL WASTES AS CARBON SOURCES IN BIOLOGICAL DENITRIFICATION,
Canada Centre for Inland Waters, Burlington (Ontario).
T. R. Bridle.
Journal of the Water Pollution Control Federation, Vol 54, No 12, p 1613, December, 1982. 1 Tab, 7 Ref.

Descriptors: *Nitrogen removal, *Denitrification, Industrial wastes, *Wastewater treatment, Biological treatment, Methanol, Organic wastes.

The low denitrification efficiencies achieved with whey in J. R. Skrinde and S. K. Bhagat's study of industrial wastes as carbon sources for denitrification, Journal of the Water Pollution Control Federation, Vol 54, page 4, 1982, were probably a result of a too-low influent COD/N ratio. Environment Canada's Wastewater Technical Center studied 30 industrial wastes as carbon sources for denitrification and found that 27 produced denitrification rates better than those achieved with methanol as the carbon source. Using pre-denitrification would further improve the nitrogen removal process by reducing oxygen requirements, the need for supplemental carbon sources, and alkalinity requirements. (Cassar-FRC)
W83-03576

ATMOSPHERIC RELEASE OF CHLORINATED ORGANIC COMPOUNDS FROM THE ACTIVATED SLUDGE PROCESS,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
P. A. Lurker, C. S. Clark, and V. J. Elia.
Journal of the Water Pollution Control Federation, Vol 54, No 12, p 1566-1573, December, 1982. 2 Fig, 5 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Organic compounds, *Source of pollutants, Fate of pollutants, Hexachlorobicycloheptadiene, Heptachlorobicyclopheptene, Chlordene, Industrial wastes, Digestion, Stabilization, Aeration basins.

Atmospheric release of chlorinated organic compounds from the activated sludge wastewater treatment process at the North plant in Memphis, Tennessee was demonstrated by field monitoring studies. The highest wastewater concentrations of the test compounds, hexachlorobicycloheptadiene, Heptachlorobicycloheptene, and chlordene, which entered the plant as components of industrial wastes, were found at the aeration basins. Comparisons of the airborne concentrations of these substances at the different aeration basin types, the contact, stabilization, and digestion indicated higher release from the contact and stabilization basins. Estimation of emission rates applying atmospheric dispersion models revealed that about 52% of hexachlorobicycloheptadiene, 21% of heptachlorobicycloheptene, and 0.61% of chlordene were released at the contact aeration basin. The demonstrated release of these contaminants suggests that more attention should be given to the air stripping of other toxic compounds at wastewater treatment plants. (Baker-FRC)
W83-03583

ENZYMATIC PRETREATMENT OF PULP MILL EFFLUENTS PRIOR TO DECOLORIZATION BY LIME PRECIPITATION,
North Carolina State Univ. at Raleigh. Dept. of Wood and Paper Science.
J. C. Campbell, and T. W. Joyce.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235457, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 197, Raleigh, May, 1983. 88 p, 22 Fig, 4 Tab, 58 Ref.

Descriptors: *Pulp and paper industry, Effluents, *Color removal, *Wastewater Treatement, Water pollution prevention, Lime, *Enzymes, Pollutants color, Industrial wastes, Bleaching wastes, Pulp wastes.

The lime precipitation process for removal of color from pulp mill effluents is a function of the molecular weight of the color molecules. Pretreatment to increase the proportion of high molecular weight color molecules could increase the efficiency of

this process. In this study, the phenol oxidase laccase was examined for its potential use as a pretreatment to increase color removal by lime. The enzyme laccase was produced in laboratory cultures of the white-rot fungus Coriolus versicolor. The concentrated culture media were used for eight-hour pretreatments of three types of effluent over a range of pH levels. Results from pretreatments of biologically-treated whole-mill effluent (BTE) showed only a limited improvement in color removal by lime. Attempts were made to improve the pretreatment by spiking BTE with o-cresol, a substrate for enzymatic reactions. However, the increase using cresol was not great enough for commercial significance. Laccase increased color removal from chlorination stage effluent to a maximum of 69%, compared to 57% for the control. Neither laccase nor laccase and cresol increased color removal from caustic extraction stage effluent. In general, pretreatment of pulp mill effluents with laccase prior to lime addition gave limited improvements in color removal efficiency. None of the increases in color removal was considered to be of the magnitude required for industrial importance.
W83-03603

INDUSTRIAL WATER REUSE WITH COUPLED-TRANSPORT MEMBRANES,
Bend Research, Inc., OR.
W. C. Babcock.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235465, Price codes: A03 in paper copy, A01 in microfiche. Completion Report OWR/RU-83-3, U.S. Dept. of the Interior, Bur. Reclamation, Washington, DC, May 1983, 35 p, 19 Fig, 3 Tab, 8 Ref. OWRT C-00194-R(No 0536)(1).

Descriptors: *Membranes, *Membrane processes, *Metal-finishing wastes, *Water reuse, *Wastewater treatment, Field tests, Distillation, Economic feasibility, Plating wastes, Rinse water, *Coupled transport, Chrome plating, Payback periods.

The program objective was to demonstrate the feasibility of using coupled-transport membranes to treat chrome-plating rinse waters. This year's efforts were directed toward field tests of small hollow-fiber-membrane units at a decorative-chrome plating shop and at a hard-chrome plating shop. Field tests at the decorative-chrome shop were conducted with a unit containing modules with 15 ft super 2 of membrane. These modules exhibited fluxes of 5 lb/ft super 2 -year and showed no deterioration in performance over the longest test (125 days). Field tests in a hard-chrome shop were also performed with 15-ft super 2 modules, but were limited to only 2 weeks due to problems caused by precipitation of iron hydroxide in the unit that fouled the modules and fibers. Based on the field-test results, an economic analysis was performed. The results show that coupled-transport treatment of decorative-chrome rinse water is economically attractive compared with distillation, which is currently used to a limited extent in the plating industry to recover chromium from rinse waters and to produce reusable rinse water. For example, a unit that will recover 5000 pounds of chromium per year will have a payback of 2.25 years, compared with a payback period of 6 years for a comparably sized distillation unit.
W83-03604

ENUMERATION OF CHLORINE-DAMAGED FECAL COLIFORMS IN WASTEWATER EFFLUENTS,
Illinois Univ. at the Medical Center, Chicago. School of Public Health.
P. J. Graham, and G. R. Brenniman.
Journal of the Water Pollution Control Federation, Vol 55, No 2, p 164-169, February, 1983. 3 Fig, 4 Tab, 27 Ref.

Descriptors: *Bacteria, *Chlorination, *Wastewater analysis, Pollutant identification, *Coliforms, Filtration, *Wastewater treatment.

Media enrichment significantly improved recovery of fecal coliforms in the conventional membrane filtration (MF) method when used to analyze samples collected at four stages of treatment in an advanced wastewater treatment plant which chlorinated the final effluent. However, this experiment did not conclusively prove that recovery rates for chlorine-damaged cells had improved. Median concentrations of fecal coliforms (cells per 100 ml) determined during the four treatment steps were: settling tank, 20,000 control and 36,000 enrichment; postchlorination, 48 control and 60 enrichment; postfiltration, 900 control and 860 enrichment; and outfall, 200 control and 400 enrichment. Chlorine residuals (mg per liter) were 2.46 in the post-chlorination stage, 0.28 after filtration, and 0.16 at the outfall, 2 miles from the plant. The aftergrowth of the bacteria was attributed to self repair of the chlorine-damaged cells and not to multiplication in the filter media. (Cassar-FRC)
W83-03632

HOW MUCH PREVENTIVE MAINTENANCE IS TOO MUCH,
G. Mellish, and C. R. Beer.
Journal of the American Water Works Association, Vol 75, No 1, p 14-15, January, 1983.

Descriptors: *Decision making, *Maintenance, *Maintenance costs, *Water management, Management planning, Wastewater treatment, Water treatment, Operating costs, Safety, Hydraulic equipment, Preventive maintenance, Wastewater treatment plants.

In a discussion of how much preventive maintenance (PM) should be included in the operation of a wastewater treatment plant, Gordon Mellish, supervisor of instrumentation of a sewage treatment plant in Toledo, Ohio and Charles R. Beer, superintendent of water treatment for the Denver Water Department, present differing viewpoints. Mellish contends that unless a PM program is realistic, it is not cost effective. To back his argument he states that his plant's magnetic flow meters and stepping switches did not require the recommended maintenance schedule suggested by the manufacturer. In addition, the routine replacement of vacuum tubes often resulted in the insertion off the wrong tubes into the sockets, causing detuning or oscillating the amplifier circuits. If maintenance checks become too tedious, Mellish believes technicians are apt to perform their jobs poorly. PM programs that replace parts that already work are too costly and any routine maintenance should be performed on a time schedule determined by actual experience with the equipment. Mr. Beer, on the other hand, believes that PM is necessary because the services provided by a water treatment plant are too important to risk downtime of equipment. Beer contends that maintenance technicians will become more familiar with the equipment, the more they inspect and repair it. Accurate records of all equipment, parts in stock, and maintenance should be kept along with a file of hard-to-get critical parts. The choice of how much PM and corrective maintenance should be performed is clearly a management decision and should be based on not only cost, but what value is placed on reliability, employee safety, and product quality. If the PM program remains flexible then better choices can be made as experience increases. (Geiger-FRC)
W83-03638

REMOVAL MECHANISMS FOR TOXIC PRIORITY POLLUTANTS,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
D. F. Kincannon, E. L. Stover, V. Nichols, and D. Medley.
Journal of the Water Pollution Control Federation, Vol 55, No 2, p 157-163, February, 1983. 6 Fig, 4 Tab, 5 Ref.

Descriptors: *Organic compounds, *Priority pollutants, *Degradation, *Wastewater treatment, Activated sludge process, Biodegradation, Adsorption, Ozonation, Stripping, Oxidation, Biological wastewater treatment, Toxicity.

Removal of a variety of priority pollutants was studied in a complete-mix, continuous flow activated sludge system, a batch reactor, and an ozonation system. In the continuous flow system removal efficiencies of 94.5->99% were attained for the 15 chemicals tested: tetrachloroethane, nitrobenzene, 2,4-dinitrophenol, acrolein, acrylonitrile, 1,2-dichloropropane, methylene chloride, ethyl acetate, benzene, 1,2-dichloroethane, phenol, 1,2-dichlorobenzene, 1,1,1-trichloroethane, 1,3-dichlorobenzene, and 2,4-dinitrophenol. Initial concentrations of the pollutants were 62-258 mg per liter. Either stripping or biodegradation, and in some cases, a combination of the two, was the effective destruction method for all compounds; sorption had an almost negligible role. In batch studies, acrylonitrile (110 mg per liter) was 99.1% removed by a combination of stripping and biodegradation. Likewise, 130 mg per liter 2,4-dinitrophenol was 63% removed and 100 mg per liter phenol was 99% removed, both totally by biodegradation. Ozone treatment made 1,2 dichloropropane biodegradable, slightly increased the biodegradability of 2,4-dinitrophenol, and decreased the biodegradability of acrylonitrile. In general, nitrogen compounds, phenols, and oxygenated compounds were removed by biodegradation; aromatics, by stripping-biodegradation; and halogenated hydrocarbons, by stripping. (Cassar-FRC)
W83-03647

THE MASONRY SEWERS OF ALEPPO,
Engineering-Science, Inc., Arcadia, CA.
R. M. Bradley, and A. Hajjar.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 6, p 437-446, December, 1982. 5 Fig, 8 Ref.

Descriptors: Wastewater collection, *Sewer systems, *Maintenance, Aleppo, *Syria, Concretes, Roughness coefficient, Cleaning, Sewer infiltration, Infiltration, *Masonry sewers.

The city of Aleppo, Syria, reputed to be the oldest continuously inhabited city in the world, has a sewer system at least 1500 years old. The system, which serves 80% of the 1 million population, is composed of 48 km of interceptor sewers and 640 km of street sewers. The sewer network, constructed of local limestone masonry blocks, operates entirely without pumping. Most sewers are rectangular, but some are of horseshoe or ovoid shape. Problems with the system include a high roughness coefficient (Manning n of 0.02), high infiltration rate, poor hydraulic characteristics in the rectangular cross sections, and frequent structural failure from increasingly heavy traffic. Maintenance and cleaning are all done by manual labor. Wastewater is relatively high in inorganic matter from washing root vegetables and from sand washed from roads and yards. The rate of corrosion from the 30-40 mg per liter sulfate and 4 mg per liter sulfide was calculated to be 0.085 mm per year, about 5 times less than for concrete sewers. The present method of sewer construction will probably be continued until concrete pipe can be manufactured locally at a competitive price. Wastewater is not treated, but is discharged to the river, which is used for irrigation. (Cassar-FRC)
W83-03655

PRELIMINARY EVALUATION OF THE PRETREATMENT OF FUEL ALCOHOL FERMENTATION STILLAGE THROUGH AN ANAEROBIC FILTER,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
R. B. Jacquez, A. Sales, and W. M. Wang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243030, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Missouri, Columbia, November 1982. 27 p, 3 Fig, 5 Tab, 14 Ref. A-124-MO(1), 14-34-0001-1127.

Descriptors: Anaerobic conditions, *Filter, *Packed bed, *Alcohols, *Wastewater treatment, *Industrial wastes, *Anaerobic bacteria, *Anaerobic digestion, Water pollution control, Methane, Chemical oxygen demand, Biochemical oxygen demand, Nutrients, Nitrogen, Phosphorus, Fermentation.

The objective of this research was to conduct a preliminary evaluation of the pretreatment of fuel alcohol fermentation stillage by means of an anaerobic filter. The first phase of the investigation was devoted to characterizing the stillage. The following observations were made based upon the characteristics: (1) the organic strength of the stillage (COD=59, 500 mg/l, BOD sub 5=26,700 mg/l) was approximately 100 times that of municipal wastewater; (2) the stillage was deficient in nitrogen (BOD:N:P=100:0.6:1.4), an essential nutrient required for satisfactory biological decomposition; (3) the pH of the stillage is acidic (pH=3.7); and (4) the suspended solids of the stillage is exceptionally high (SS=10,500 mg/1). The second phase of the investigation studied the reduction of suspended solids by centrifugation. A centrifugation speed of 1000 rpm for five minutes was demonstrated to optimize suspended solids removal (91% removal). In the third phase of the investigation laboratory scale anaerobic filters were tested as a means of pretreating the fermentation stillage. Prior to being used as the filter feed, the stillage was centrifuged to remove suspended solids, neutralized to pH 7.0, and was supplemented with nitrogen to a BOD:N:P ratio of 100:5:1. The filters were operated at organic loads ranging from 32 to 214 lbs COD/1000 ft super 3/day which produced operating efficiencies of 49-94% COD removal. Methane gas production ranged between 4.4 to 10.5 ft super 3 CH sub 4/lb COD destroyed. Overall, the anaerobic filter was demonstrated to be an effective means of pretreating fermentation stillage.
W83-03664

THE USE OF FIELD CROP RESIDUES FOR SAND FILTER MODIFICATION OF SMALL COMMUNITY WASTEWATER STABILIZATION PONDS TO MEET SECONDARY TREATMENT REQUIREMENTS AND RECOVERY OF PLANT NUTRIENT RESOURCES,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
D. E. Modesitt, and S. G. Swanback.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243048, Price codes: A03 in paper copy, A01 in microfiche. Missouri Water Resources Research Center Completion Report, Univ. of Missouri, Columbia, November 1981. 39 p, 10 Fig, 1 Tab, 15 Ref. A-126-MO(1), 14-34-0001-1127.

Descriptors: *Oxidation lagoons, *Sewage lagoons, Sewage effluents, *Filters *Wastewater treatment, Water pollution control, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen, Phosphorous, *Filtration, Field Crops(residue), Harvesting of algae, *Sand filters.

Comparisons were made of laboratory scale intermittent sand filters for upgrading wastewater lagoon effluent. Three filters were used. Two were modified with a 45.7 cm (18 in) cover of corn stalks or sunflower stalks. The hydraulic loading rate 4700 m super 3. ha/d (0.5 mgad) applied in two equal doses daily. The effective sand size was 0.18 mm. The lagoon effluent characteristics during the study period averaged 102 mg/l SS, 42 mg/l BOD sub 5, 169 mg/l COD, 11.4 mg/l TKN, and 2.7 mg/l total P. The filters were operated 57 days before the corn stalk covered filter clogged. All filter effluents averaged less than 30 mg/l BOD sub 5 (13.5 - 18 mg/l). Only the corn stalk covered filter averaged less than 30 mg/l SS (23 mg/l). The unmodified filter effluent had the greatest SS (44 mg/l average). Effluent COD values were similar (68 to 76 mg/l). TKN values were 1.5 mg/l for unmodified filter and 3.6 mg/l for the one with corn stalks. The lowest average total P (1.0 mg/l) was produced by the corn stalk covered filter. No significant recovery of P or N was achieved on the crop residue. Modification of intermittent sand filters may provide increased pollutant reduction.
W83-03665

AN INNOVATIVE APPROACH OF OPERATING ROTATING BIOLOGICAL CONTACTOR USING PURE OXYGEN,
Missouri Water Resources Research Center, Columbia.
J. C. Huang, C. E. McCann, and Y. C. Liu.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243055, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, November 1982. 33 p, 6 Fig, 2 Tab, 18 Ref. A-123-MO(1), 14-34-0001-1127 and 2127.

Descriptors: *Biological treatment, *Oxygenation, *Wastewater treatment, Microbial activity, *Rotating biological contactor, *Biodiscs, Films, Waste stabilization, Fixed films.

Three laboratory-scale rotating biological contactors (RBC) were used to evaluate the effect of oxygen availability on the microbial buildup and the related waste stabilization activity in the RBC system. One of the RBC units was exposed to air while the other two were subjected to pure-oxygen inputs at 146 and 365 g 0 sub 2/m super 2/day, respectively. The three units were operated in parallel and three different organic laoding rates, 82.5, 150 and 310 g COD/m super 2/day, were imposed in separate experimental runs. The results of this study have shown that not only the amount of microbial buildup is affected by the oxygen input, but the waste stabilization activity per unit biomass is also dictated by the oxygen availability. It has also been observed that about 70 to 80% of the total biomass in an RBC system exists as the fixed film while the remaining 20 to 30% exists as the suspended biological flocs. With a fixed film thickness of 5 to 6 mm, an aerobic condition cannot be maintained throughout the attached-growth layer when the DO in the mixed liquor is below 3 or 4 mg/l. If the biomass inside an RBC system is kept thoroughly aerobic, the biomass can achieve a specific COD reduction rate of 0.96 g COD/day/g VS when the F/M ratio is equal to 1.0. On the contrary, if the biomass is under either an anoxic or an anaerobic condition, its waste stabilization activity would be reduced by about one-third, or equivalent to having a specific COD reduction rate of 0.62 g COD/day/g VS.
W83-03666

DISPOSAL OF HOUSEHOLD WASTEWATER IN SOILS OF HIGH STONE CONTENT,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
E. M. Rutledge, C. R. Mote, M. S. Hirsch, H. D. Scott, and D. T. Mitchell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243188, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 99, Univ. of Arkansas, Fayetteville, May 1983. 140 p, 22 Fig, 11 Tab, 53 Ref, 1 Append. OWRT B-052-ARK(1), 14-34-0001-1204.

Descriptors: *Septic tank systems, Filter fields, *Soil adsorption systems, Effluent renovation, Septic tank effluent treatment, Frgiudults, Loamy-skeltal soils, Soils-stony, Climatic stress periods, *Filters, *Wastewater treatment, *Wastewater disposal.

Two experimental septic tank filter fields were constructed with built-in monitoring equipment in Nixa soils. These soils contain many chert fragments and a fragipan about 60 cm deep which restricts downward water movement and is the design-limiting feature. The standard filter field (76 cm deep) was built into the fragipan and the modified standard filter field (30 cm deep) was placed above it. During 30 months observation, the modified standard performed better than the standard filter field. Maximum rise of effluent in the standard and modified standard came within 11 and 19 cm of the soil surface, respectively. Performance of these systems indicates filter fields should be designed to function during climatic stresses, i.e., when the soil has a maximum hydraulic load and surfacing may occur. Filter fields should be designed to withstand a stress period of specified intensity. The filter fields in this study were observed under less than normal stress. Therefore, their long range performance is less clear. Our observations indicate that filter field performance is related more to rates of water movement than to stone content. Major influences on filter field performance are rates and directions of water movement, stress period intensity, designs and construction techniques.
W83-03679

BIOLOGICAL TREATMENT OF CYANIDE IN HIGH-STRENGTH COKE-PLANT WASTEWATER,
Alabama Univ. in Birmingham. Dept. of Biology.
D. D. Jones.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246462, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Compeletion Report, Auburn Univ., Ala., July 1983. 4 p. OWRT A-084-ALA(1), 14-34-0001-2101.

Descriptors: *Coke-plant wastewater, *Wastewater treatment, *Cyanide, *Biological treatment, Bulking sludge, Filamentous growth, Ammonia liquor.

Coke-plant wastewater contains a variety of compounds including phenol (300-4000 mg/l), ammonia (1300-2000 mg/l), cyanide (10-100 mg/l) and thiocyanate (10-100 mg/l). Wastewater tratment plants have microbial populatins adapted to treat wastewater processed in an ammonia still to reduce the concentration of toxic constituents, particularly ammonia and cyanide. A microbial population already adapted to treating coke-plant wastewater subjected to steam stripping was further acclimated to treat a wastewater containing an average of 350 mg/l TOC (250 mg/l phenol), 40 mg/l thiocyanate, 175 mg/l ammonia and 200 mg/l cyanide fed to bench-scale reactors at a hydraulic retention time of 42 hours. The reactor was operated at a solids retention time of 50 days and a temperature of 35C. The mixed liquor suspended solids decreased from 3000 mg/l to approximately 1000 mg/l after 230 days operation. The nitrifying bacteria did not become significantly more tolerant to cyanide in the complete-mix system since the cyanide degraders provided protection from the inhibiting effects of cyanide. Phenol and thiocyanate removal were unaffected by additions of cyanide. High organic loadings (TOC, 1000 mg/l) of coke-plant wastewater led to the development of filamentous growth and bulking sludge. Once established, such treatments as alkaline pH, exposure to hydrogen peroxide, and wasting of the biomass at a 4% or greater rate did not reduce the filamentous population. Operating at elevated temperatures (42C) effectively reduces the filamentous growth and improves settleability while maintaining good effluent quality. The primary difficulty in treating high-strength coke-plant wastewater appears to be the general toxicity that occurs at higher organic loadings that decreases the microbial efficiency.
W83-03697

WASTE WATER TREATMENT BY LIGAND EXCHANGE,
Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.
F. R. Groves, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246553, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, June 1983. 22 p, 17 Fig, 5 Tab, 16 Ref. OWRT A-055-LA(1), 14-34-0001-2120.

Descriptors: Ammonia, Aqueous waste, *Ion exchange, *Ligand exchange, *Wastewater treatment, Amines, Phenols, Resins, Wastewater treatment facilities.

Ligand exchange is a water purification process in which a pollutant is removed by complexing with an ion held on an ion exchange resin. The objective of this research was to explore the use of ligand exchange for removal of ammonia, amines, and phenols from dilute (150 mg/L aqueous solution). Ammonia and amines were successfully removed by complexing with copper (II) ion held on a cation exchange resin. Breakthrough curves and equilibrium curves were obtained experimentally for ammonia, ethylamine, diethylamine, ethanolamine, and butyl amine on the copper (II) - Amberlite IRC-50 resin system. The ammonia data were successfully correlated by a mathematical model of the ligand exchange process. An attempt was made to treat dilute solutions of phenol, resorcinol, and pyrogallol by complexing with borate held on two kinds of resins. Ligand exchange was unsuccessful

for this application. The phenols displaced th borate and were held irreversibly on the resin. A preliminary economic study was done for a ligand exchange plant to treat one million gallons per day of water containing 150 mg/L of ammonia. Based on use of exhaust steam as a heat source for regeneration a treatment cost of $0.285 per thousand gallons was determined. Ligand exchange should be competitive with such processes as activated carbon adsorption and conventional ion exchange.
W83-03706

ADAPTATION OF AN ACTIVATED SLUDGE PROCESS TO THE TREATMENT OF COKE-PLANT WASTEWATER CONTAINING HIGH LEVELS OF CYANIDE,
Alabama Univ. in Birmingham. Dept. of Biology.
D. Harden.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246942, Price codes: A05 in paper copy, A01 in microfiche. M. S. Thesis, University of Alabama, Birmingham, 1983. 75 p, 10 Fig, 13 Tab, 37 Ref. OWRT A-084-ALA, 14-34-0001-2101.

Descriptors: *Cyanide, *Wastewater treatment, Wastewater, *Biological wastewater treatment, Industrial wastewater, Sludge, *Activated sludge.

Cyanide occurs in the wastewater of a variety of industries, particularly those involved in steel production, metal plating, coal gasification and in the manufacture of chemicals, plastics and pharmaceuticals. Because of its toxicity, cyanide is generally removed from wastewaters by chemical and physical methods, including alkaline chlorination, complexation and aidification, prior to biological treatment. It is now apparent that in some cases wastewater containing cyanide can be treated using conventional biological processes. One major goal of this research was to determine whether a microbial population treating coke-plant wastewater could be adapted to treat high levels of cyanide influent. A second major goal was to determine what measurable differences exist after adaptation between a population receiving high levels of influent cyanide and one receiving low levels. Methods of comparison included oxygen utilization and viable plate counts in the presence of cyanide, as well as measurements of nitrification and phenol removal in the presence of cyanide. The final goal of this research was to determine some of the characteristics of the organisms responsible for cyanide degradation in the coke-plant wastewater treatment environment.
W83-03710

PHASE AND COMPRESSION BEHAVIOR IN SEDIMENTATION AND THICKENING OF LIQUID-SOLID SUSPENSIONS,
Auburn Univ., AL. Dept. of Chemical Engineering.
T. D. Placek.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249664, Price codes: A02 in paper copy, A01 in microfiche. Completion report, July 13, 1983. 12 p, 1 Fig, 1 Tab, 7 Ref. OWRT A-086-ALA(1), 14-34-0001-2101.

Descriptors: *Sludge thickening, *Wastewater treatment, *Model studies, Mathematical analysis, Flocculation, Settling basins.

Theoretical work has recently been to allow batch settling data to be more successfully used to design continuous thickening process equipment particularly at medium to high solids concentrations. The model developed allows the mathematical description of clarifiers and thickeners operating in the compression zone regime. This work was conducted to obtain the required data to both validate the new model as well as to compare its reliability to other currently used models such as Oltmann, Talmage and Fitch, Wilhelm and Naide, and Coe and Clevenger. Additional experimental work was performed to investigate to what extent batch and continuous thickeners are affected by rheological variants such as shear history and surface effects as well as to consider the significance of phase behavior such as channelling. Laboratory work included the construction of a prototype continuous thickener having excellent performance characteristics as well as making refinements in the standard data collection and treatment methods.
W83-03727

COMPARATIVE EVALUATION OF MATHEMATICAL MODELS USED FOR CALCULATING BIOLOGICAL FILTERS,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. A. Vavilin, and S. S. Kuz'min.
Water Resources (English Translation), Vol 9, No 2, p 193-199, March-April, 1982. 1 Fig, 2 Tab, 18 Ref. Translated from Vodnye Resursy, No 2, p 109-115, March-April, 1982.

Descriptors: *Mathematical models, *Wastewater treatment, *Biofilters, Filtration, Oxidation, Bacteria, Mass transfer, Substrates, Filters.

The processes of oxidation of individual substrates or pollutants and of multicomponent pollutants such as wastewaters are examined. When describing the process of biochemical oxidation of monosubstrates a sufficiently adequate model of the biofilter is the Monod-type model, the limiting cases of which are described by equations of zeroth and first order reactions. The constant of the Monod model as well as the rate constant of the zeroth and first order reaction can be estimated from the diffusion model of oxidation of a monosubstrate by a biofilm. For multicomponent pollutants such as wastewaters the most adequate to the prototype are not classical models of the Monod type but rather models of higher orders of the reaction. (Baker-FRC)
W83-03735

HARVESTING OF ALGAE GROWN ON RAW SEWAGE,
National Inst. for Water Research, Pretoria (South Africa).
J. M. P. Viviers, and J. H. Briers.
Water SA, Vol 8, No 4, p 178-186, 1982. 6 Fig, 8 Tab, 13 Ref.

Descriptors: *Algae harvesting, *Dewatering, *Aqua culture, Algal growth, Sewage, Sludge dewatering, *Wastewater treatment, Nutrients, *Flotation.

Results pertaining to the definition and optimization of some of the engineering parameters which are important for the practical implementation of the harvesting of algae grown on raw sewage are reviewed. Harvesting comprises three separate but interdependent processes: separation, dewatering and drying. Three flotation techniques, dissolved air flotation (DAF), dissolved oxygen flotation (DOF) and induced air flotation (IAF), were compared for separation. An algal production pond of 260 square meters was operated with raw sewage. DAF in conjunction with aluminum sulfate as flocculant yielded a slurry containing 2 to 3% dry solids; with a cationic polyelectrolyte (Praestol 444K) a slurry containing up to 8% dry solids was obtained. The latter slurry showed superior dewatering characteristics in comparison with the alum derived slurry. Retention of the float layer in the cell for more than one hour before scraping results in a biomass concentration of up to 8% solids, which represents an improvement of about 60% over continuous scraping. The polyelectrolyte sludge is amenable to further dewatering on a screen, resulting in a solids concentration of up to 12%. Drum drying of the algal sludge resulted in a final product containing up to 56% protein, putting it in line with soya bean and fish meal in terms of quality. An estimated initial capital outlay saving of 25% is possible on utilizing the DOF technique, with a possible 11 to 12% savings on running costs, as compared with DAF, which requires air/water saturation. (Baker-FRC)
W83-03737

THE MODULAR APPROACH TO SEWAGE TREATMENT.
Water Services, Vol 86, No 1041, p 544-545, 547, 1982.

Descriptors: *Wastewater treatment, *Sludge blanket, Sludge, Suspended solids, Modular approach.

A modular system is now being marketed which is able to monitor most of the common parameters found in water and sewage treatment. An original one-shot multi-vibrator sensing the cutting off of transmitted light by a rising sludge blanket is used to trip a sequence of lights and relay contacts to give visual and audible warning of a rising blanket. The system was experiencing some difficulty. After a period of trials and development a two-light source system, each with an independent receiver gathering some scattered and some direct light, was fed into an AND gate IC, thus requiring all light sources to be occluded before the warning trips were activated. The sensor is mounted on the end of heavy duty screened cable which has level indications marked every half meter, and this is itself suspended on a boom in the tank, usually on the revolving gantry. A separate relay contact is supplied in the weatherproof housing, with the main amplifier and power supply unit, so that a telemetry link may be used to feed the information back to a central receiving laboratory. A further design using a remote IR transmitter/receiver system is now under consideration. (Baker-FRC)
W83-03741

TOTAL WATER MANAGEMENT--THE DENVER STORY,
CH2M/Hill, Denver, CO. Water Engineering Dept.
K. J. Miller.
Public Works, Vol 114, No 2, p 38-39, February, 1983. 1 Fig.

Descriptors: *Water reuse, *Irrigation water, *Reclaimed water, Denver, *Colorado, Water treatment, Water distribution, Wastewater treatment, Water reuse.

Several communities in Colorado use treated wastewater effluent for irrigation of golf courses and landscape plantings. Denver is installing a plant to produce potable water from wastewater as part of its water distribution system expansion, which also includes a 300 ft high diversion dam and a 3.4 mile diversion tunnel. The pilot plant reuse facility consists of primary and secondary treatment, chemical coagulation and settling, carbon dioxide neutralization, filtration, ammonia extraction, organic chemical removal by activated carbon adsorption in two steps, ozonation, demineralization, aeration, and disinfection with chlorine dioxide. For the next 5-7 years water quality will be monitored for 200 potentially harmful viruses, bacteria, and chemicals. (Cassar-FRC)
W83-03746

BUILDING SEWER RENOVATION--A KEY TO SUCCESSFUL I/I CONTROL,
C. H. Steketee, and R. Beck.
Public Works, Vol 114, No 1, p 46-50, January, 1983. 2 Fig.

Descriptors: *Sewer systems, *Rehabilitation, *Sewer infiltration, Leakage, Grouting, Inspection, Infiltration, Lateral sewers.

Repair of building laterals was an important factor in reducing infiltration/inflow (I/I) in several sewer systems. Castle Rock, Washington, population 2000, reduced I/I by 60% by replacing the many deteriorated laterals and grouting all the major I/I contributing areas in the main sewers. In a 67-home pilot program at Salem, Oregon, 28 of 31 building sewers failed an air test. All but 3 were repaired without excavation. Problems in handling building sewer inspection and repair are divided ownership and construction responsibilities, difficult access, inadequacy of leak detection methods (smoke tests or TV inspection), and poor construction of main connections. Some methods used for repairing leaky building laterals include plug and grout, sock sleeve packers, sliplining with polyethylene pipe, and a snake. (Cassar-FRC)
W83-03747

COLUMN DESIGN FOR RECOVERY OF NH3 AND CO2 FROM WASTEWATER IN A UREA PLANT,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Chemical Engineering.
R. H. Weiland, and J. Litster.
Separation Science and Technology, Vol 16, No 10, p 1339-1354, 1981. 2 Fig, 2 Tab, 19 Ref.

Descriptors: *Chemical recovery, *Wastewater treatment, *Industrial wastewater, *Ammonia, *Carbon dioxide, *Urea, Chemical reactions, Chemical industry, Design criteria, Model studies, Separation techniques, Mass transfer, Energy, Ammonium compounds, Heating.

A sequential section-to-section calculation procedure is proposed for the stripping of carbon dioxide and ammonia from a chemically reactive dilute aqueous solution in a packed column, where the gases are present mostly as ammonium carbamate which decomposes under heating. The need to recover these gases from a wastewater stream from a urea plant containing up to 3% of each gas motivated the study. Analysis of the stripping process is based on a film model. Several pilot-scale experiments were conducted to validate the model. The model was programmed to predict column height required to produce a specified lean bottoms composition from a given feed concentration and rate when column operating pressure and overhead vapor rate are stipulated. For each section, mass and energy balances were determined, and calculations proceeded sequentially from section to section. Iterative calculation was used within sections to establish mass transfer rates. Comparison of predicted and experimental column height required to perform six separations showed that the experimental packed height was 1.64 m, while the predicted height was 1.52 m with a standard deviation of plus or minus 0.23 m (15%). Section-to-section models are preferrable to block tridiagonal matrix formulations where flows and compositions can be completely specified for the feed and closely estimated for overhead vapor. Use of a fundamental or mechanistic model makes optimization of column design possible. (Gish-FRC)
W83-03748

SUB-SURFACE AERATOR/MIXING UNITS.
Water Services, Vol 86, No 1041, p 549, 553, 1982. 1 Fig.

Descriptors: *Activated sludge processes, *Wastewater treatment, Wastewater treatment facilities, *Aeration, Oxidation, Oxygen, Helixor, Reservoirs, Destratification.

Sub-surface aerator/mixing units are extremely versatile. Representative units of this type, Helixors, were first used as submerged aerators/mixers in wastewater treatment lagoons as well as in lakes and reservoirs to overcome thermal stratification and the related problem of depleted oxygen levels. Such systems are now incorporated in conventional and extended aeration activated sludge plants, balance tank and pH control facilities, anaerobic and aerobic digester sludge mixing, reservoir destratification, oxidation of sulfides and phenols. Three basic engineering principles of oxygen transfer are employed: large interfacial contact, provided by small air bubbles; prolonged interfacial contact, provided by the helix component causing the mixture of air and water to travel more than twice the distance of the height; and turbulent flow provided by spiral velocities in excess of 1.25 m/sec. The Helixor's ability to life vast quantities of liquor ensures maximum mixing of the polluting material and microorganisms. (Baker-FRC)
W83-03763

INDUSTRIAL WASTEWATER PRETREATMENT STANDARDS--A LOCAL APPROACH,
Burns and McDonnell, Kansas City, MO.
For primary bibliographic entry see Field 6F.
W83-03765

WATER QUALITY IN THE FIRTH OF FORTH,
Napier Coll., Edinburgh (Scotland). Dept. of Biological Sciences.
P. A. Read, K. J. Anderson, J. E. Matthews, P. G. Watson, and M. C. Halliday.
Marine Pollution Bulletin, Vol 13, No 12, p 421-425, December, 1982. 4 Fig, 2 Tab, 30 Ref.

Descriptors: *Water quality, *Wastewater treatment, Outfalls, Outfall sewers, Sediments, Metals, Mussels, Firth of Forth, Edinburgh, Primary wastewater treatment, *Scotland.

In the Firth of Forth a long term monitoring program has been undertaken to assess the environmental impact of a new sewage treatment scheme for the City of Edinburgh. Water quality along the Edinburgh coastal zone was tested in terms of selected chemical parameters. The ecology of Edinburgh coastal zone was investigated by means of studies of plants and animal populations of the foreshore and to determine the reasons for any changes detected. The fecal contamination of sea water was also examined, and shellfish were studied using bacterial indicators. Techniques for isolating viruses from polluted sea water and shellfish were used to study viral contamination along the coastal zone. Techniques were established to analyzed low concentrations of heavy metals in sea water, sediments and marine organisms, and these techniques were used to investigate heavy metal contamination along the coastal zone. A significant improvement has been noted in the water quality and environmental quality of the south shore of the outer Firth of Forth, most notably along the Edinburgh coastal zone since the opening of the primary sewage treatment works, complete with long sea outfall in 1978. A marked drop was noted in fecal pollution of sea water along the coastal zone. Levels of trace metals in sediments, sea water and mussels in the area has been found to be generally of the same order as in other estuaries of the United Kingdom. (Baker-FRC)
W83-03784

REMOVAL OF PHOSPHATES,
T. Stones.
Effluent and Water Treatment Journal, Vol 22, No 12, p 466-467, December, 1982. 6 Tab, 7 Ref.

Descriptors: *Phosphorous removal, *Wastewater treatment, *Phosphates, Sedimentation, Activated sludge process, Filtration.

Phosphate removal from sewage was investigated. A 12-hour detention period in a sedimentation tank reduced influent phosphate of 5.73 mgm per liter by 23%. This was not a result of biological activity. Sterilized and unsterilized sewage removed 31.8% and 31.9%, respectively, upon 18 hours settlement. Of the chemical coagulants tested at 400 mgm per liter, lime removed 88%; aluminum sulfate, 93.6%; and sulfuric acid, 26.7% of phosphate. Bilogical filtration removed 31.7% of phosphate; activated sludge treatment, 64-71%. (Cassar-FRC)
W83-03791

PILOT PLANT EXPERIMENTS ON THE PHYSICO-CHEMICAL TREATMENT OF MEAT PROCESSING EFFLUENTS,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
I. Tookos.
Effluent and Water Treatment Journal, Vol 22, No 11, p 421-423, 425, 427, November, 1982. 2 Fig, 4 Tab, 7 Ref.

Descriptors: *Flotation, *Chemical precipitation, *Meat processing industry, *Wastewater treatment, Poultry, Sedimentation, Coagulation, Flocculation, Proteins, Lime, Physicohemical treatment.

Treatment of meat and poultry processing effluents was studied on the pilot plant scale. A dissolved air flotation process proved more efficient than a sedimentation process. For precipitating the protein, there were three suitable methods: flocculation around the isoelectric point of the proteins, coagulation with conventional chemicals such as aluminum hydroxide or ferric compounds, and lime precipitation at pH higher than 10 with addition of chemical coagulants. Choice of a treatment system depends on the size of the individual plant and on the intended use for the sludge (as animal feed or discarded). In general, flotation is recommended for larger plants and sedimentation for smaller plants. (Cassar-FRC).
W83-03792

COMPACT NITROGEN REMOVAL OPTIONS FOR LAKE COMO,
L. K. Wang.
Effluent and Water Treatment Journal, Vol 22, No 11, p 435, 437, November, 1982. 18 Ref.

Descriptors: *Nitrogen removal, *Denitrification, *Wastewater treatment, Ion exchange, Biological wastewater treatment, Reverse osmosis, Electrodialysis, Membrane processes, Rotating biological contactor, Lake Como, *Italy, Nitrification, Nitrates, Ammonia, Chlorination.

The compact wastewater treatment facilities for a resort (design population 8000) at Lake Como, Italy, are housed in an old stone boathouse. This paper reviews technically and economically feasible nitrogen removal methods for secondary dissolved air flotation effluent which require little additional space. These include biological nitrification by rotating biological contactor or denitrification filters, ion exchange, reverse osmosis, electrodialysis, breakpoint chlorination, and ammonia stripping. Processes less suitable for this compact facility are conventional coagulation, lime softening, and ferrous iron with a copper catalyst. (Cassar-FRC)
W83-03793

REMOVAL OF NITRILOTRIACETIC ACID DURING PRIMARY SEDIMENTATION AND ITS EFFECT ON METAL REMOVAL,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
A. C. Rossin, J. N. Lester, and R. Perry.
Environmental Pollution, Series B, Vol 4, No 4, p 315-330, 1982. 4 Fig, 4 Tab, 29 Ref.

Descriptors: *Nitrilotriacetic acid, *Detergents, *Metals, *Wastewater treatment, Water pollution effects, Fate of pollutants, Primary wastewater treatment, Sedimentation, Heavy metals, Suspended solids, Lead, Nickel, Zinc, Cadmium, Chromium, Copper.

The removal of nitrilotriacetic acid (NTA), a detergent builder, during primary sedimentation was studied in 2 pilot plants operated in parallel, one acting as a control. Hydraulic loadings were varied over the range representative of normal sewage treatment works operation. NTA was added at 15 or 30 mg per liter and was varied around these concentrations to simulate diurnal fluctuation. NTA removal was 16-40%, primarily by adsorption onto settleable solids. NTA removal was not correlated with suspended solids removal. No correlation between suspended solids removal and NTA removal was seen. The presence of NTA significantly reduced removals of Pb, Ni, and Zn, but had little effect on removals of Cd, Cr, and Cu. (Cassar-FRC)
W83-03813

ALTERNATIVE WASTEWATER MANAGEMENT STRATEGIES FOR RURAL AND URBAN-FRINGE COMMUNITIES,
Nova Scotia Dept. of Municipal Affairs, Halifax. Community Planning Div.
P. C. Campbell.
Canadian Journal of Civil Engineering, Vol 9, No 4, p 586-594, December, 1982. 16 Ref.

Descriptors: *Septic tanks, *Wastewater management, Management, *Wastewater treatment, Municipal wastewater, *Nova Scotia.

Rapid expansion of conventional municipal water and sewer systems into the rural areas of Nova Scotia during the 1960's has left many communities with systems which are expensive to operate and

maintain. In addition, many private and small community septic tank systems are malfunctioning. As a result, less costly alternative approaches for wastewater management are being considered. These include septic treatment and ground disposal or soil absorption. A 1978 report demonstrated that the alternative systems are feasible with proper site evaluation and professional management. A demonstration project at Port Maitland illustrated a system using 4 centralized cluster systems with community septic tanks and disposal in contour trenches. Thus far, savings in capital and operating costs have been 45-50% over a conventional system. The municipality is preparing to take over management of the system. (Cassar-FRC)
W83-03823

ACTIVATED CARBON FOR TREATMENT OF CADMIUM WASTEWATER,
Delaware Univ., Newark.
C. P. Huang, and P. K. Wirth.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1280-1299, December, 1982. 16 Fig, 4 Tab, 27 Ref.

Descriptors: *Wastewater treatment, *Adsorption, *Cadmium, *Activated carbon, *Industrial wastes, *Electroplating, Heavy metals, Adsorbents, Carbon, Regeneration, Hydrogen ion concentration, Economic aspects.

The removal of cadmium (Cd) by activated carbon from the wastewater effluents of industries using the Cd-electroplating process has received much attention in the 1970's. The adsorption characteristics of Cd(II) from Cd(II)-BF4 plating solution on granular or powdered activated carbons were examined in both batch mode and continuous flow experiments. The powdered activated carbon was bound to spheres using a suspension-polymerization procedure. Results showed that at all pH values, powdered activated carbons such as Nuchar SA and Nuchar SN exhibited greater Cd(II) removal capacity than the granular ones such as Darco HD3000 and Filtrasorb 400. The adsorption capacity of the aggregated carbons was 85-90% of the unbound ones. At pH 7, the rate of Cd(II) removal was found to be proportional to the Cd concentration, the carbon dose, and the available surface sites. Used activated carbons could be regenerated with strong acids such as HCl, HC104, and H2S04. Two treatment schemes, a completely mixed flow reactor activated carbon adsorption treatment system (with carbon regeneration) and a column reactor activated carbon adsorption system (with carbon regeneration) are proposed, along with economic analyses for comparison with other common treatment processes. (Geiger-FRC)
W83-03825

EFFECT OF POLYELECTROLYTES ON BIOFILM GROWTH,
Escuela Politecnica Nacional, Quito (Ecuador).
E. J. La Motta, R. F. Hickey, and J. F. Buydos.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1326-1341, December, 1982. 7 Fig, 48 Ref.

Descriptors: *Polymers, *Polyelectrolytes, *Biological wastewater treatment, *Biological membranes, *Literature review, *Wastewater treatment, Nitrification, Cations, Anaerobic conditions, Sewage bacteria, Reviews.

During nitrification and anaerobic carbon removal in wastewater treatment processes, biofilm attachment and growth may take several weeks or even months. The literature describing bacterial attachment and growth is reviewed. The effect of surface conditioners made from synthetic and naturally produced polymers on the rate of biofilm attachment and growth was investigated in batch experiments using the continuous flow rotating disk reactor with primary sewage as substrate. The rate of biofilm attachment and growth was accelerated by use of a cationic polymer precoat (American Cyanamid 2535, Percol 722 or Calgon WT 2640) on the surface of the media before the final biofilm is induced to grow. Precoating with naturally produced biopolymers enhanced biofilm growth of nitrifiers and substrate conversion even more effectively than precoating with synthetic cationic polymers. However, in full scale engineering applications, the extraction of biopolymers would be too impractical and expensive to warrant their use as a precoat. (Geiger-FRC)
W83-03826

ANAEROBIC DIGESTION OF WASTE ACTIVATED SLUDGE,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. M. Gossett, and R. L. Belser.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1101-1120, December, 1982. 10 Fig, 2 Tab, 22 Ref.

Descriptors: *Mathematical models, Model studies, *Activated sludge process, *Anaerobic digestion, *Sludge digestion, Activated sludge, Biological treatment, *Wastewater treatment, Mathematical studies, Kinetics, Biodegradation.

The effect of solids retention time in the activated sludge process on the performance of anaerobic digesters fed the resulting waste sludges was evaluated in model studies. Activated sludge systems were operated over various solids retention times and the waste sludges were used as feed sources for batch and semicontinuous anaerobic digestion studies. Previously described models for aerobic biodegradability of activated sludges gave accurate predictions of ultimate anaerobic digestibility. However, traditional kinetic models of digestion overestimated actual performance with this substrate. An activated sludge anaerobic digestion model was formulated which incorporates a first-order rate mechanism for preliminary conversion of viable activated sludge biomass into available anaerobic substrate. A decrease in solids retention time causes an increase in sludge for digestion. However, these solids are more digestable, so that both the quantity of digested solids for ultimate disposal and the cost of digestion are virtually independent of the solids retention time. (Geiger-FRC)
W83-03827

CLARIFICATION FAILURE CONTROL STRATEGIES,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
T. M. Keinath, and V. D. Laquidara.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1121-1127, December, 1982. 8 Fig, 2 Tab, 1 Ref.

Descriptors: Process control, *Clarification, *Suspended solids, *Activated sludge process, *Mixed liquor solids, *Wastewater treatment, Activated sludge, Steady flow, Sludge thickening, Sludge, Solids, Aeration.

Two solids inventory control strategies for the prevention of clarification failure in the activated sludge process are proposed. The mechanisms of clarification failure are explained in terms of a clarification failure analysis diagram. Recycle rate control is shown to be effective for only a certain class of operational situations, usually where steady-state conditions prevail. It is not applicable to situations where an activated sludge system is experiencing severe hydraulic surges. Effective solids inventory control for all situations where clarifiers are overloaded with respect to both thickening and clarification can be achieved only through the step feed control strategy in which the location of the feed to the aeration basin is shifted downstream in a multiphase basin. (Geiger-FRC)
W83-03828

INNOVATIVE APPROACHES TO SEWAGE COLLECTION, TREATMENT, AND DISPOSAL: PRACTICES IN NORTHERN CANADA,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
D. W. Smith, and V. Christensen.
Canadian Journal of Civil Engineering, Vol 9, No 4, p 653-662, December, 1982. 10 Fig, 11 Tab, 19 Ref.

Descriptors: *Cold regions, *Wastewater disposal, *Sewer systems, *Wastewater treatment, Wastewater management, Wastewater lagoons, Wastewater collection, *Canada, Pipes, Truck collection, Land disposal, Lagoons, Water conservation, Waste disposal, Lakes, Disinfection, Ozonation.

Wastewater management in northern Canada (Yukon and Northwest Territories) has undergone significant changes in the past 10 years. Among the innovations are use of butt-welded polyethylene pipe for sewer lines, individually insulated water and sewer lines between the mains and the household connection, and trucked collection of wastes. For undiluted wastes a system to macerate the collected plastic bags is under development. However, the method for capturing plastic fragments before effluent discharge has not yet been successful. Few innovations have been made in treating moderately diluted wastewater such as holding tank contents. Ponds and pits are most frequently used. Lagoons, frequently used to treat conventionally diluted wastewater, have been modified in three ways: lagoon with discharge to a swamp, lagoon with discharge to the land surface, and a chain of lakes. Dilute wastewater is usually treated by screening followed by discharge into lagoons. Some research is being done on rotating biological contactors and ozone treatment for this dilute effluent. For greywater disposal, a sand filter followed by disinfection has been suggested but is not yet widely used. A program to publicize methods for conserving potable water is expected to reduce consumption by 40-60%. (Cassar-FRC)
W83-03840

5E. Ultimate Disposal Of Wastes

INVESTIGATION OF THE SOLIDIFICATION OF WASTEWATER CONCENTRATES WITH INORGANIC BINDING AGENTS (UNTERSUCHUNGEN UBER DIE VERFESTIGUNG VON ABWASSERKONZENTRATEN MIT ANORGANISCHEN BINDEMITTELN),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
R. Wagner.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 14, No 4, p 119-131, August, 1981. 6 Fig, 13 Tab, 29 Ref.

Descriptors: *Sludge disposal, *Cements, *Gypsum, *Leaching, *Solid wastes, Sludge thickening, Water pollution control, Wastewater disposal, Waste disposal, Federal Republic of Germany.

Certain mixtures of high-alumina cement and gypsum, supplemented as necessary with lime hydrate and added in amounts of 0.6 to 2.75 kg/liter, are capable of transforming liquid or sludge-type wastes into solid matter. The results of elution tests showed that some wastewater pollutants (different metal ions, organic substances) are contained in the solidified material in a readily leachable form, and others in a more strongly bound form. The solidification process results in a decrease in the mobility of the pollutants above and beyond a mere adsorption effect, depending on the setting and aging time. (Author's abstract)
W83-03505

LAND APPLICATION OF SEWAGE SLUDGE LANDFILL LEACHATE,
Rhode Island Univ., Kingston. Dept. of Plant and Soil Science.
W. R. Wright, and H. J. Brown.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-227389, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center Completion Report, Univ. of Rhode Island, Kingston, December 1982. 18 p, 10 Tab, 6 Ref. OWRT A-078-RI(1), 14-34-0001-2142.

Descriptors: *Heavy metals, Nitrogen, Groundwater pollution, *Leachates, *Sludge, Landfills, *Wastewater disposal, Septic sludge, Water pollution sources, Soil chemistry.

This investigation evaluated the feasibility of the 'living filter' concept as an alternative method of heavy metal leachate disposal to prevent contamination of groundwaters. Leachate collected from a simulated sewage sludge landfill was applied at rates of 0, 200, 400, and 600, Kg N/ha/yr to plots of rye grass (L. perenne) to evaluate the attenuation of contaminants. The concentrations of metals Cd, Cu, Fe, Ni, Pb, and Zn, as well as nitrogen content, were analyzed over a 5 month period in soil, soil-water lysimeter extracts, and grass samples before, during and after application of landfill leachate. Exchangeable nitrogen (NH4 + NO3 + NO2) concentrations in soil were significantly higher at the 600. Kg, KgN/ha/yr rate while significantly greater concentrations were retained within the surface 30 cms. Soil-water extracts were significantly higher at the 400 and 600 Kg N/ha/yr rate and also highest in the surface layers. The concentrations of metals in the soil and soil-water extracts remained generally unchanged statistically. Yields of rye grass did not differ significantly within the three rates of N application, but exchangeable nitrogen was highest at the 600 KgN/ha/yr rate. In general, heavy metal accumulation in the soil was not a problem but nitrogen contamination to ground-waters could be of legitimate concern when applying sewage sludge landfill leachate to a grass crop.
W83-03563

VARIABLES AFFECTING METAL REMOVAL FROM SLUDGE,
Ethyl Corp., Baton Rouge, LA.
D. J. Wozniak, and J. Y. C. Huang.
Journal of the Water Pollution Control Federation, Vol 54, No 12, p 1574-1580, December, 1982. 5 Fig, 1 Tab, 21 Ref.

Descriptors: *Wastewater treatment, *Metals, *Activated sludge process, Sludge, Sludge treatment, Acidity, Suspended solids.

The pertinent variables affecting the efficiency of acidification for the removal of the heavy metals cadmium, chromium, copper, lead, nickel, and zinc from wastewater treatment sludge solids were sought. Metal removals were found to be dependent on the pH, the solids concentrations, the specific type of metal, and the length of acidification time. Solubilization rates and ultimate removal efficiencies for all metals investigated increased with time and with decreasing pH and solids concentrations. For many cases, limitations in the extent of metal solubilization exist, depending on pH and solids concentrations. The orders of metal removal vary, depending on the pH. Of interest in the chromium and nickel removals were the large amounts of the metals removed immediately after acid addition. For both of these metals, the initial solubilization represented over half of the total metal able to be solubilized under the specific conditions, which might indicate that a significant portion of these metals existed as inorganic precipitates or as weakly chelated forms within or on the sludge solids. Acid usage in the metal solubilization process was dependent on the concentration of sludge solids, the desired pH value, and the length of time needed to maintain the pH. For most of th metals investigated a solids concentration of 1% may be optimal for metal removal and acid savings. (Baker-FRC)
W83-03581

ASSESSMENT OF HEAVY METALS AND PCBS AT SLUDGE APPLICATION SITES,
Canada Centre for Inland Waters, Burlington (Ontario).
M. D. Webber, H. D. Monteith, and D. G. M. Corneau.
Journal of the Water Pollution Control Federation, Vol 55, No 2, p 187-195, February, 1983. 2 Fig, 8 Tab, 15 Ref.

Descriptors: *Sludge disposal, Metals, *Land application, Fate of pollutants, Land disposal, *Polychlorinated biphenyls, *Heavy metals, *Ontario, Agriculture.

Heavy metals and polychlorinated biphenyls (PCB's) were assessed in soils and plant matter from 10 Ontario wastewater sludge land application sites. The sites were chosen to represent a variety of soil types, sludge applications from 1 to 21 years and 9 to 90 tons per ha total, and a variety of loadings of the different contaminants. In general, sludge treatment increased the total metal and PCB contents of soils. Largest increases in pollutant levels were found in soils with the greatest estimated sludge loadings. Mean pollutant levels in sludge treated soils (micrograms per g, air dry weight) were: Cd, 1.06; Zn, 190; Cu, 41.1; Ni, 27.2; Pb, 37.8; and PCB's, 0.142. Metals extractable by diethylenetriamine pentaacetic acid in the receiving soils were also higher in control soils and were well correlated with total metals. Except for Zn there were few significant effects of sludge treatment on crop composition (corn and oats). There was no apparent PCB uptake from contaminated soils. Most plant materials had metals and PCB levels within normal ranges, except for corn from the Stratford site, which contained excessive Mo levels. It is believed that application of sludge according to Ontario Sludge Utilization Guidelines is unlikely to cause deleterious uptake of heavy metals by field crops. (Cassar-FRC)
W83-03633

FINE-COAL-AIDED CENTRIFUGAL DEWATERING OF WASTE ACTIVATED SLUDGE,
Enviro Enterprises, Inc., Salt Lake City, UT.
O. E. Albertson, and M. Kopper.
Journal of the Water Pollution Control Federation, Vol 55, No 2, p 145-156, February, 1983. 8 Fig, 11 Tab, 13 Ref.

Descriptors: *Sludge solids, *Coal, *Dewatering, Sludge conditioning, Flocculation, Polyelectrolytes, Centrifugation, Sludge solids, Incineration, Filtration, Waste treatment, Wastewater disposal.

Adding fine coal to waste activated sludge, flocculating with polyelectrolytes, and centrifuging in a new type slow speed, co-current scroll centrifuge significantly reduced the moisture content of the resulting sludge cake. During about 80 full-scale tests optimum operating conditions were developed to yield a coal/sludge cake of 25-37% solids with addition of polymer and 0.1 to 0.3 kg coal per kg of sludge solids. Using polymers without coal addition achieved cake solids of 18-23% totol solids. Fuel savings for incineration ranged from 60 to 90%. Retrofitting existing vacuum filter furnace installations with co-current centrifuges using fine coal plus polymers could increase furnace capacities 30-100% and pay back retorfitting cost within about a year. (Cassar-FRC)
W83-03659

MAGNESIUM RECYCLING BY CARBONATION AND CENTRIFUGATION OF HIGH-LIME WASTEWATER SLUDGE,
Tahal Consulting Engineers Ltd., Tel-Aviv (Israel).
E. Idelovitch, and A. M. Wachs.
Journal of the Water Pollution Control Federation, Vol 55, No 2, p 136-144, February, 1983. 10 Fig, 5 Tab, 13 Ref.

Descriptors: *Magnesium compounds, *Dewatering, *Lime, Carbonates, Bicarbonates, Sludge conditioning, Oxidation ponds, Polyelectrolytes, Boron, Fate of pollutants, Heavy metals, Phosphorus, Organic matter, *Recycling, Waste treatment, Waste disposal.

High-lime treatment of secondary wastewater effluent or raw wastewater produces a sludge high in Mg(OH)2 and difficult to dewater. This paper describes a process to dissolve the Mg for recycling. This increases sludge cake dewatering capacity and solids content and reduces polyelectrolyte requirements. Effluents were obtained from wastewater oxidation ponds in the Dan Region, Israel. Carbon dioxide is bubbled through the sludge to reduce the pH to about 9 to form a mixture of magnesium carbonate and magnesium bicarbonate with a dissolution efficiency of 35-40%. Dissolved magnesium is recovered from the sludge solids by centrifugation with polyelectrolyte addition. The dissolved Mg is recycled directly to the lime treatment process, which required about 35-45 mg per liter total Mg. In this process neither Ca nor the undesirable materials (organics, phosphorus, or heavy metals) are dissolved to an appreciable extent. Although reduction of the pH to 8 improves efficiency to 50-60% and forms magnesium bicarbonate exclusively, it dissolves considerable boron, which is harmful to crops. (Cassar-FRC)
W83-03660

DEVELOPMENT OF A REGIONAL SLUDGE DEWATERING FACILITY USING PRESSURE FILTERS,
Black and Veatch, Denver, CO.
G. F. Shimp, C. P. Houck, and B. Baumgartner.
Journal of the Water Pollution Control Federation, Vol 55, No 2, p 130-135, February, 1983. 1 Fig, 5 Tab.

Descriptors: *Sludge disposal, *Dewatering, *Regional development, Sludge conditioning, Sludge solids, Summit County, Colorado, Filters, Waste treatment, Waste disposal.

A regional sludge handling and disposal facility for Summit County, Colorado, a ski area, started up in April 1981. Sludge is hauled by truck from 5 municipal treatment plants to the sludge handling plant, based on pressure filtration. Processed sludge is currently landfilled, but will be available for land reclamation and game lands fertilization when these beneficial uses develop. The user charges are based on a base fee, a gallonage charge, and a solids loading charge. (Cassar-FRC)
W83-03661

WATER QUALITY IN THE FIRTH OF FORTH,
Napier Coll., Edinburgh (Scotland). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5D.
W83-03784

FILTRABILITY AND COMPRESSIBILITY OF SLUDGES, PART 1,
Nigeria Univ., Nsukka.
J. O. Ademiluyi, U. G. N. Anazodo, and N. Egbuniwe.
Effluent and Water Treatment Journal, Vol 22, No 11, p 428-431, November, 1982. 5 Fig, 2 Tab, 9 Ref.

Descriptors: *Filtration, *Compressibility, *Dewatering, Sludge, Sludge treatment, Sludge handling, Sludge disposal, Wastewater treatment.

An effort to experimentally determine the value of the exponent b in the basic equation used to describe the sludge filtration process at constant pressure was not conclusive. Buchner funnels of different sizes were used to determine the relationship between filtrate volume (V) and area (A). The exponent b, the slope of log V vs. log A, was calculated to be 0.91 + or - 0.02. Substituting the higher and lower values in the equation produced disparate values of specific resistance (R). Until the problem of obtaining a more precise value for the actual area of filtration can be solved, it is suggested that specific resistance of sludges can be calculated from: (1) Carman's equation, using the total area of the Buchner funnel as the total area, (2) the dimensional equation, using the filtration area measured as the effective area of the Buchner funnel, or (3) the partial dimensional equation, which produces the value of the exponent b. (Cassar-FRC)
W83-03790

LANDFILL MANAGEMENT AND LEACHATE QUALITY,
J. F. Rees.
Effluent and Water Treatment Journal, Vol 22, No 12, p 457, 459, 460, 462-463, December, 1982. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Landfills, *Leachates, *Waste dumps, Carboxylic acids, Domestic wastes, Solid wastes, Water quality control, Methane, Bacteria, Microbial degradation, Degradation, Chelation, Metals, Fate of pollutants.

Conditions favoring good quality of leachate (minimum total carboxylic acids) from domestic refuse landfills are the presence of water, a high degree of microbial activity, high pH, low oxidation/reduction potential, and rapid fermentation (generates sulfides and carbonates to precipitate heavy metals). Low refuse density (0.35 tons per cu m) produced aerobic decomposition similar to composting, with very little carboxylic acid leaching. Refuse at a density of 0.95 tons per cu m produced a leachate much higher in carboxylic acids than refuse placed at a density of 0.67 tons per cu m. Pulverized refuse produced higher carboxylic acid levels in leachates than crude refuse. Allowing liquids to rise through the landfill (by bumping or rising groundwater) as opposed to letting liquids percolate downwards improved conditions for methanogenesis. In establishing a new landfill, conditions for methane production may be enhanced by using low-density refuse (0.35 tons per cu m) for the base, mixing of wood and paper with domestic refuse, and adding water to the base of the landfill. (Cassar-FRC)
W83-03812

TOTAL ORGANIC HALOGEN (TOX) CONCENTRATIONS IN THE WEST LAFAYETTE WASTEWATER TREATMENT PLANT EFFLUENT AND THE WABASH RIVER,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
J. M. Bell, and R. D. Buesink.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-253310, Price codes: A08 in paper copy, A01 in microfiche. Technical Report No 160, August 1971. 143 p, 13 Fig, 45 Tab, 135 Ref, 1 Append. OWRT-A-063-IND(1).

Descriptors: *Halogens, *Organic compounds, *Wastewater treatment, Chlorination, Wabash River, West Lafayette, *Indiana, Chlorinated organic compounds, *Total organic halogens.

The magnitude of the chlorinated organic compounds was determined in the Wabash River and in the effluent at the West Lafayette Wastewater Treatment Plant (WLWTP). All samples were tested using an activated carbon adsorption procedure followed by pyrolysis with quantification via microcoulometric titration system. The mean upstream Total Organic Halogen(TOX) concentration was 10.7 mug/1. The mean downstream TOX concentration was 9.5 mug/1. The upstream TOX concentrations were not significantly different from season to season, nor were the upstream and downstream TOX concentrations. The unchlorinated WLWTP effluent mean TOX concentration was 30.0 mug/1 while the chlorinated effluent mean TOX was 66.7 mug/1. The portion of the chlorine demand associated with the TOX concentration was 1.41% in the WLWTP. A mass balance revealed that the increase in TOX, after complete mixing in the river would only be 2.33 mug/l, which would not be detectable. Field observations confirmed that the downstream TOX concentrations were not significantly different from the upstream concentrations. The impact on the Wabash River of chlorinated organics in the WLWTP effluent can be considered relatively minimal.
W83-03819

5F. Water Treatment and Quality Alteration

GROWTH OF THE MUNICIPAL WATER SYSTEM IN CIUDAD JUAREZ, MEXICO,
Texas Univ. at Austin. Dept. of Geological Sciences.
W. J. Lloyd.
Natural Rsources Journal, Vol 22 No 4, p 943-955, October, 1982. 4 Fig, 32 Ref.

Descriptors: *Juarez, *Water distribution, *Water supply development, *Costs, Water conveyance, Groundwater mining, Wells, Water supply, Water metering, *Mexico, Water shortage, Urban areas, Rio Grande, Water requirements, Cindad Juarez.

Current water resources and the water system of Ciudad Juarez (Mexico) are discussed, and implications for the future are considered. All city water is pumped from underground reserves of the Hueco Bolson aquifer, which underlines the city. Mexico's share of the Rio Grande water is totally committed for agriculture. Domestic water consumption averages 299.5 liters/capita/day. Water is distributed to households either through private water taps in homes or private courtyards or through public taps along the streets. Some water is also delivered in barrels or trucks. 90% of the population now have direct access to water. The city's population is expected to exceed 2,000,000 by the year 2000, which means the level of water service must also expand. The city has a goal of a production level of 360 liters/capita/, day with a direct service service target of 85%. Thus, the number of wells will be increased to 104 by the mid-1990s, which will give a well capacity of 5500 liters/sec. An increase in the use of water meters may be necessary to pay for the new wells an expanded distribution system. (Small-FRC)
W83-03502

BACTERIAL GROWTH ON ION EXCHANGE RESIN - INVESTIGATIONS WITH A STRONG CATIONIC EXCHANGER. PART 1: ATTACHMENT AND DISTRIBUTION OF BACTERIA: OPERATIONAL POSSIBILITIES OF SUPRESSING BACTERIAL GROWTH (BAKTERIENWACHSTUM AUF IONENAUSTAUSCHERHARZ-UNTERSUCHUNGEN AN EINEM STARK SAUREN KATIONEN-AUSTAUSCHER. TEIL 1: ANHAFTUNG UND VERTEILUNG DER BAKTERIEN; BETRIEBLICHE MOGLICHKEITEN DER WACHSTUMS-UNTERDRUCKUNG),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
H-C. Flemming.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 14, No 4, p 132-139, August, 1981. 8 Fig, 8 Tab, 36 Ref.

Descriptors: *Ion exchange, *Resins, *Bacteria, *Growth rates, *Water treatment, Growth, Sodium chloride, Disinfection, Closed systems, Backwash, Monitoring, Cations, Federal Republic of Germany.

A review is presented of bacterial growth on ion exchange resins including the attachment and distribution of bacteria and methods to supress bacterial growth. Bacteria are not necessarily attached securely to the surfaces of an ion exchange resin. They can, for example, be easily washed off the strongly acidic cation exchanger Llewatit S 100. On this exchanger, the bacteria are distributed inhomogeneously in the resin bed in the form of 'nests'. The number of nests in the upper region of the ion exchange column is normally higher than the number in the lower region. Continuous operation or keeping the resin in the generation agent during off-periods are possible methods for suppressing bacteria growth. A 20% sodium chloride solution can suppress generation over a longer period of time. Insufficient methods which cannot replace disinfection of the resin include closed-loop operation, back-flushing, and regeneration. Ion exchange resin units must be subjected to routine bacterial monitoring in all cases where there are hygienic implications to their use. (Small-FRC)
W83-03507

ON THE METHODOLOGY OF DESIGN AND USE OF MONITORING AND CONTROL PROGRAMS FOR GROUNDWATER MANAGEMENT FACILITIES (ZUR METHODIK DES AUFBAUS UND DER NUTZUNG VON KONTROLL- UND STEUERUNGSPROGRAMMEN VON GRUNDWASSERFASSUNGSANLAGEN),
Technische Univ., Dresden (German D.R.). Bereich Hydrobiologie.
L. Luckner, and W. Nestler.
Wasserwirtschaft-Wassertechnik, Vol 32, No 7, p 219-223, July, 1982. 7 Fig, 1 Tab, 14 Ref. (No English Summary).

Descriptors: *Groundwater management, *Automation, *Computer programs, *Forecasting, *Water treatment facilities, Artificial recharge, Water distribution, Drinking water, Water demand, Water quality management, Water quality control, Water resources development, Monitoring, Monitoring and control programs, *German Democratic Republic, Mathematical equations.

Recommendations are made for automated monitoring and control systems for groundwater management facilities in the German Democratic Republic. These are necessary because more than 70% of the projected 3-4% yearly increase in water demand must be met by existing groundwater facilities. A unified total hardware and software suitable for all groundwater works should be developed. It should be capable of modification to fit each facility individually with different levels of control; it should be of modular design, be user-friendly, reliable, and use state-developed technology; it should be efficient in terms of manpower, dead time, stability/flexibility, costs, and adaptability; it should be capable of incremental incorporation of water quality considerations into all aspects of groundwater management; and it should make it possible for each facility to operate optimally within the total system. Programs with internal data processing are necessary for the control of artificial recharge facilities, particularly those with difficult-to-manage reservoir volumes (small time constants). A suggested system contains modules for input, command variable size (primarily the development of a drinking-water demand projection), generation of water distribution variables, analysis of present and projected situations, simulation of volume and quality dynamics, data storage and updating, and output. Examples are given of East German facilities at which some or all of these modules are used. (Gish-FRC)
W83-03522

THE MID-TERM EXTENSION PROGRAM FOR THE BODENSEE-WASSERVERSORGUNG (DER MITTELFRISTIGE AUSBAU DER BODENSEE-WASSERVERSORGUNG),
Bodensee-Wasserversorgung, Stuttgart (Germany, F.R.).
G. Naber.
Wasserwirtschaft, Vol 71, No 3, p 61-68, March, 1981. 9 Fig, 15 Ref. English summary.

Descriptors: *Water supply development, *Water resources development, *Water management, *Water conveyance, *Drinking water, Resources development, Potential water supply, Resources managment, Treatment facilities, Pipelines, *Federal Republic of Germany.

Following the rapid development of the Bodensee-Wasserversorgung (BWV), these was a consolidation phase during the nineteen-seventies. Under the so-called Mid-term Extension Program, considerable funds were invested in order to increase the reliability of supply and to improve the existing facilities. This program included the following projects: extension of the pumping facilities and treatment plants at Sipplingen, extension of the pipe network, and creation of additional storage capacity in the main centers of consumption. Due to its sound technical and economical basis, the BWV, the largest and most modern long distance water supply system in Germany, is now in a position to extend its own supply area as well as supplying Rheital, taking advantage of the Rheintal groundwater. (Author's abstract)
W83-03523

METHODOLOGY FOR DETERMINING THE PRESENCE AND ORIGIN OF ORGANIC MICROPOLLUTANTS,
Compagnie Generale des Eaux, Paris (France).
A. Guiraud, and J. Larnicol.
Water Science and Technology, Vol 14, No 12, p 127-142, 1982. 17 Fig, 12 Ref.

Descriptors: *Water treatment, *Organic compounds, Chromatography, Mass spectrometry, Oise River, Source of pollutants, Fate of pollutants, River basins, *France, *Pollutant identification.

An approach is described for the determination of organic micropollutants in the Oise River. The objectives of the approach are to locate the origin of possible micropollutants in the Oise water which may cause problems during treatment, distribution or consumption of the drinking water produced at the Mery-sur-Oise plant. Treatment at this plant combines the full range of existing processes, both physicochemical and biological. The conventional method of searching for organic micropollutants consists of carrying out a series of analysis in a medium to identify a certain number of undesirable substances and following their development in the stream. The existence of a drinking water production process detracts from the interest in testing for a number of micropollutants, since they are removed at various stages of the treatment process. Nevertheless, the protection of chemical and biological reactors requires that certain micropollutants be eliminated before the beginning of the treatment sequence. The analytical method used is gas or liquid chromatography; where identification is essential, a combination of mass spectrometry and liquid chromatography is used. The notion of a chromatogram or mass spectra bank is essential. The assumption underlying the method's validity is that the discharge likely to contain in large part the substances creating problems is that which usually contains them in small part. There is good indication to believe that this method can improve the identification and above all the elimination of the sources of micropollutants for the modern treatment of surface water intended for the production of drinking water. (Baker-FRC)
W83-03548

THE ELIMINATION OF MINERAL MICROPOLLUTANTS,
Compagnie Intercommunale Bruxelloise des Eaux (Belgium).
For primary bibliographic entry see Field 5D.
W83-03556

REMOVAL OF RADON FROM WATER USING GRANULAR ACTIVATED CARBON ADSORPTION,
Maine Univ. at Orono. Dept. of Civil Engineering.
J. D. Lowry.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-227397, Price codes: A03 in paper copy, A01 in microfiche. Land and Water Resources Center Completion Report, Univ. of Maine, Orono, June 1983. 31 p, 10 Fig, 1 Tab. OWRT A-057-ME(2), 14-34-0001-2121.

Descriptors: *Activated carbon, Adsorption, *Radioactivity, Radioisotopes, *Water treament, *Radon.

A concise summary is presented of the current knowledge on radon removal using granular activated carbon (GAC) treatment. The technical information is based upon laboratory and field research and it is presented in a question-and-answer format designed to provide information to persons considering a method to remove radon from a household groundwater supply. The questions addressed range in scope from basic ones like 'What is Radon.' to more complex ones associated with the buildup of radon daughters and gamma activity within the GAC bed. Other pertinent topics discussed and explained include: 1) type of GAC to use, 2) required capacity of GAC unit, 3) shielding considerations for GAC units, 4) effective life of a bed, 5) backwash requirements for GAC units, and 6) cost of GAC treatment. Research results show that a GAC unit is more cost effective than spray or diffused aeration. A typical 2.5 cu. ft. unit is capable of greater than 95% removal and will cost less than $10/year to operate and maintain. Initial costs ranges from about $450 to $800 depending upon capacity.
W83-03564

MONITORING WATER QUALITY PARAMETERS FROM MUNICIPAL WATER INTAKES,
Stroh Brewery Co., Detroit, MI.
J. J. Kubus, and D. A. Egloff.
Journal of the Water Pollution Control Federation, Vol 54, No 12, p 1592-1598, December, 1982. 4 Tab, 15 Ref.

Descriptors: *Water quality, *Monitoring, *Water treatment facilities, Drinking water, Municipal water supply, Statistical analysis, Lakes, *Lake Erie, *Ohio, *Regression analysis.

Water quality changes due to passage through municipal water intake systems were assessed in light of whether any changes were similar for different treatment plants and for different water quality parameters, and whether any of the observed changes were sufficiently constant to permit a statistically reliable estimation of lake values from plant values. Using regression analysis, water quality was monitored at each of three intakes on the Ohio shore of Lake Erie on four dates over a 12 month period. Significant regression equations were determined for 14 varibles, including temperature, conductivity, dissolved oxygen, alkalinity, nitrogen, phosphorus, silica, sodium, chloride, suspended solids, turbidity, and chlorophyll. Only rarely did plant values equal lake values. Significant increases or decreases occurred in the values of all parameters during passage of the water through the pipe at one or more of the intake sites. If water intakes are to be used to collect water quality data, regression equations for each parameter should be developed to account for changes in water quality introduced by the pumping system. (Baker-FRC)
W83-03568

THE EFFECT OF STRESS ON ORGANISMS IN THE DISTRIBUTION SYSTEM,
Delaware Univ., Newark. School of Life and Health Sciences.
For primary bibliographic entry see Field 5A.
W83-03602

THE REACTIONS OF CHLORINE DISINFECTANT WITH ORGANICS ADSORBED ON GRANULAR ACTIVATED CARBON,
Florida Water Resources Research Center, Gainesville.
J. J. McCreary, K. R. Batsel, and J. R. Rivera.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-236166, Price codes: A05 in paper copy, A01 in microfiche. Publication No 70, June 1983. 82 p, 32 Fig, 23 Tab, 32 Ref, 1 Append. OWRT A-048-FLA(1), 14-34-0001-2110.

Descriptors: *Activated carbon, *Chlorine, *Organic compounds, Mutagenicity, *Water treatment, Disinfection, Adsorption, Humic acids, Fulvic acids.

The reactions of aqueous free chlorine with two organic molecules were examined before and after adsorption on granular activated carbon. The molecules were both typical of subunits of naturally-occuring humic and fulvic acids. Reactions were conducted at chlorine/carbon ratios and at carbon column flowrates typical of those encountered in water treatment practice. It was observed that carbon catalyzed the hydroxylation of the aromatic ring in all reactions, even when chlorine was not present in the influent to the column. It was also observed that large molecular weight products could form, presumably via a free-radical mechanism at the carbon surface. The products of all reactions were determined by capillary GC/MS and in some cases, high resolution GC/MS was employed for additional structural information. Reaction of one organic at a higher pH produced similar products to those found at neutral pH. This work was then extended to the clorination of a fulvic acid water sample on activated carbon. The carbon at the influent end of the column contained compounds that were mutagenic in the Ames test, and had innumerable phthalates and fatty acid methyl esters.
W83-03624

CHLORAMINES - AN ANSWER TO THE TRIHALOMETHANE PROBLEM,
Delta Chemicals, Inc., Searsport, ME.
M. A. Dullea.
Journal of the New England Water Works Association, Vol 96, No 4, p 361-368, December, 1982. 2 Fig.

Descriptors: *Chloramines, *Trihalomethanes, Water quality control, Water pollution sources, Ammonium sulfate, Chlorine, Organic matter, Acidity, Temperature effects, *Water treatment.

The recent EPA mandated limits on chloroform and other trihalomethanes (THM) in drinking water are discussed. Many utilities have no difficulty in meeting this THM limit, others may have a problem only sporadically, and some may have a persistent problem. Key factors affecting THM concentration in final drinking water are: organic precursors naturally occurring in water such as humus and fulvic substances, amount of free chlorine coming in contact with the organic matter, presence of other halogen ions, contact time, temperature, and pH. Free chlorine in contact with natural organic precursors is at the heart of the problem. Utilities chlorinating surface water have the biggest problem. The simplest solution is alternate chemical disinfection. Of the alternatives, chloramines will play a significant role. A simple, efficient, non-hazardous route to chloramines is through the use of Food Chemical Codex grade ammonium sulfate. (Baker-FRC)
W83-03625

HOW MUCH PREVENTIVE MAINTENANCE IS TOO MUCH,
For primary bibliographic entry see Field 5D.
W83-03638

USING WATER DISTRIBUTION SYSTEM MODELS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 8B.
W83-03641

THE HISTORY OF WASTE DETECTION IN SEVERN-TRENT WATER AUTHORITY'S DERWENT DIVISION,
J. W. West.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 6, p 405-414, December, 1982. 2 Fig, 1 Tab.

Descriptors: *Leakage, *Water metering, Water distribution, History, Water loss, Derwent, *England, *Water treatment.

Detection of waste in the Derwent Division, Severn-Trent Water Authority, prior to 1975 consisted of handling direct complaints of leaks, district metering, and minimum night lines. The emphasis from 1975 to 1978 shifted to the minimum night line approach combined with district metering. In 1978 the policy was revised to include installation of waste water meters throughout the entire division. Unaccounted for water in 1982 was about 1/5 of daily consumption, slightly less than in previous years. (Cassar-FRC)
W83-03654

A SYSTEMATIC STUDY TO REDUCE TRIHALOMETHANE PRECURSORS IN LITTLE ROCK DRINKING WATER BY COMBINED ALUM COAGULATION/POWDERED ACTIVATED CARBON TREATMENT,
Arkansas Univ. at Little Rock. Dept. of Chemistry.
A. U. Shaikh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246389, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 101, University of Arkansas, Fayetteville, June 1983. 45 p, 10 Fig, 3 Tab, 30 Ref. OWRT A-057-ARK(1), 14-34-0001-0104.

Descriptors: *Powdered activated carbon, *Trihalomethanes, Chloroform, Bromoform, Bromodichloromethane, Dibromochloromethane, *THM precursors, Humic acid, *Direct aqueous injection, Solvent extraction, Gas chromatography, *Alum coagulation, Drinking water, *Arkansas, Little Rock, Water treatment.

Studies have been conducted to evaluate powdered activated carbon (PAC) as an agent for controlling trihalomethanes in drinking water. Laboratory studies indicate that PAC is highly efficient in removing free trihalomethanes in water within a few hours. The removal efficiency of humic acid, a known THM precursor, by PAC is considerably less. However, longer treatment time can remove the precursors quite significantly. Humic substances in surface water samples can also be removed by PAC.
W83-03683

AN INVESTIGATION OF THE CHEMISTRY OF DEGRADATION OF PESTICIDES AND OTHER SERIOUS ORGANIC CONTAMINANTS IN DRINKING WATER FOR APPLICATION TO DOMESTIC AND COMMUNITY WATER SUPPLIES,
New York State Coll. of Human Ecology, Ithaca. Dept. of Design and Environmental Analysis.
A. T. Lemley, and G. E. Janauer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249649, Price codes: A02 in paper copy, A01 in microfiche. Center for Environmental Research Completion Report, July 1983. 3 p. OWRT A-093-NY(1), 14-34-0001-0134.

Descriptors: *Aldicarb, Groundwater, *Ion exchange, *Pesticides, *Carbamates, Analytical methods, Community water supplies, Domestic wells, *New York, Long Island, Suffolk County, Leaching, Drinking water, *Wastewater treatment, Pollutant identification.

The systemic pesticide, Temik, has leached to ground water in Suffolk County on eastern Long Island. Its active ingredient, Aldicarb, leaches through certain soils into ground water after systemic application; this has created serious problems with drinking water on Long Island and in other parts of the country. A novel approach to treating carbamate contaminated drinking water has been investigated and found to be successful on the laboratory scale. It was reported earlier that acid catalyzed hydrolysis and nucleophilic cleavage of organophosphate pesticides are effectively achieved in situ on ion exchange beds charged with protons or hydroxyl ions. Similar experiments with Aldicarb and its environmental oxidation products, both batch equilibrium studies and mini columns, have demonstrated virtually complete detoxification of part per million to part per billion level solutions. Base and acid hydrolysis degradation rates for Aldicarb/metabolites in solution under a variety of conditions have also been determined. A systematic correlation of batch contact data with column and fundamental solution data is currently under investigation. Analytical methods for detection and quantification of the Aldicarb species have also been developed and refined. HPLC using a UV detector, a reverse phase column, and methanol/water as the mobile phase has been combined with simple preconcentration procedures to give a rapid and reliable 'flow through' technique which does not require bulk extraction or cleanup of water samples. A new gas chromatographic method has been perfected for quantification of solutions at the ppb level.
W83-03725

TOTAL WATER MANAGEMENT--THE DENVER STORY,
CH2M/Hill, Denver, CO. Water Engineering Dept.
For primary bibliographic entry see Field 5D.
W83-03746

MODERN TREATMENT IN THE MIDDLE EAST.
Water and Waste Treatment, Vol 25, No 3, p 34, 36, March, 1982.

Descriptors: *Desalination, *Arid regions, *Saline water, *Water treatment, *Membrane processes, Dissolved solids, Wastewater treatment, Middle East, Egypt, Libya.

Water treatment for the Middle East is customized to fit wide variations in population density, industrial activity, water supply, and total dissolved solids content. For example, high Fe levels in a Libyan village water supply were treated with iron removal, filtration, and disinfection, instead of the customary desalination techniques. Membrane processes such as electrodialysis and reverse osmosis are frequently used for saline water treatment, replacing distillation with its high capital and energy costs. Package sewage plants are increasing in popularity for towns, hotels, and construction camps. (Cassar-FRC)
W83-03764

SOURCES OF TRIHALOMETHANES AND OTHER C1 AND C2 HALO-ORGANICS IN POTABLE WATER,
J. Prest.
Effluent and Water Treatment Journal, Vol 22, No 12, p 449-452, 454-456, December, 1982. 1 Fig, 5 Tab, 12 Ref.

Descriptors: *Chlorination, *Organic compounds, *Water treatment, Trihalomethanes, *Chlorinated hydrocarbons, Chloroform, Hurleston Treatment Plant, *England, Water pollution sources, Fate of pollutants.

Trihalomethanes (THM) were determined in treated water from the Hurleston water treatment works in England over a 7-month period. The major halogenated organics were chloroform and bromodichloromethane, with smaller amounts of dibromochloromethane and on one occasion only, bromoform. Concentrations of THMs varied greatly with season (29 micrograms per liter in February and 50-64 micrograms per liter in summer), source of raw water (higher in raw water containing sewage effluent), and mode of water treatment (30 micrograms per liter with prechlorination and 8 micrograms per liter with postchlorination and activated carbon treatment). The rate of THM production was slow, taking up to 12 hours to reach a maximum concentration. Organochlorine contaminants in the liquid chlorine used to treat water were 32-74 mg per kg chloroform and lesser amounts of other compounds. The source of bromine in the finished water was raw water, not impurities in the chlorine added for treatment. (Cassar-FRC)
W83-03799

EFFECT OF COPPER ON NITROGEN FIXATION AND GROWTH OF BLUE-GREEN ALGAE IN NATURAL PLANKTON ASSOCIATIONS,
California Univ., Davis. Div. of Environmental Studies.
W. A. Wurtsbaugh, and A. J. Horne.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 12, p 1636-1641, December, 1982. 4 Fig, 1 Tab, 32 Ref.

Descriptors: *Algicides, *Copper, *Toxicity, Water treatment, Aphanizomenon flos-aquae, Algae, Diatoms, *Cyanophyta, *Nitrogen fixation, Nutrients, Phytoplankton, Lakes, Growth rates, Eutrophied lakes, Clear Lake, *California, Chelation.

Bioassays to assess copper toxicity were performed during a bloom of Aphanizomenon flos-aquae in eutrophic Clear Lake, California, during six 5-7 day periods in April and May 1973. Inhibition of nitrogen fixation, carbon fixation, and pigment accumulation increased linearly between 10 and 30 micrograms Cu per liter. Increasing the Cu concentrations to 75 micrograms per liter did not greatly increase toxicity to algae. At very low Cu levels (2 micrograms per liter) algal growth was stimulated. Copper did not have an inhibitory effect on nitrogen fixation without a comparable or greater effect on carbon fixation or chlorophyll a. Pennate diatoms growing with the Aphanizomenon were less sensitive to Cu; growth was not inhibited at concentrations up to 20 Cu micrograms per liter. Before adding algicide short-term bioassays should be conducted to determine the effects of a lake's chelation and sediment detoxification properties, since the minimum effective dose can vary widely between lakes and at different times of the year. For Clear Lake the effective dose was determined to be 30-75 micrograms Cu per liter. (Cassar-FRC)
W83-03837

5G. Water Quality Control

PRINCIPLES FOR TRANSBOUNDARY GROUNDWATER POLLUTION CONTROL,
L. A. Teclaff.
Natural Resources Journal, Vol 22, No 4, p 1065-1079, October, 1982. 47 Ref.

Descriptors: *Water pollution control, *Groundwater, *Legal aspects, Monitoring, Water pollution sources, Surface water, International law.

The effective regulation of transboundary groundwater pollution lags behind the evolution of rules for transfrontier surface water pollution. The sources of groundwater pollution are frequently more numerous and more widely distributed than in the case of surface water contamination and, while many of them arise from water-related activities, others have nothing whatever to do with water use per se. Groundwaters store contamination, and the process is often irreversible. Monitoring is more difficult than for surface waters. The first need in transboundary pollution control is to develop rules for the collection and dissemination of information. Once an adequate data base has been established for a transboundary groundwater resource, the next task is classification. This classification provides a basis for the establishment of standards and the adoption of management practices, recharge zone protection, land use regulation and other measures for groundwater protection. For the fullest protection of a groundwater resource some land use regulation is essential, especially in the critical recharge area of an aquifer. Although awareness of the dangeer of groundwater pollution is increasing, the binding effect of remedial rules may be indefinitely delayed if left to the slow process of creating customary international law. Regional and local entities can play a useful role as adjuncts to a commission of wider areal jurisdiction. (Baker-FRC)
W83-03501

EVOLUTION OF NITRATE CONCENTRATIONS IN GROUNDWATER IN THE MIDDLE VAUD REGION (SWITZERLAND) (EVOLUTION DES CONCENTRATIONS EN NITRATES DES EAUX SOUTERRAINES DU MOYEN-PAYS VAUDOIS),
Inspectorat Cantonnal des Eaux, Lausanne (Switzerland).
For primary bibliographic entry see Field 5B.
W83-03508

SANITARY MONITORING OF SEAWATER IN BATHING AREAS OF FRANCE (SURVEILLANCE SANITAIRE DES EAUX DE BAIGNADE EN MER EN FRANCE),
Ministere de la Sante et de la Securite Sociale, Paris (France)
D. Tricard.
Progress in Water Technology, Vol 12, No 4, p 543-552, 1980. 1 Tab.

Descriptors: *Coliforms, *Coastal waters, *Swimming, *Monitoring, *Water quality, Public health, Bacteria, Water pollution, Feces, Streptococcus, Seasonal variation, Coastal zone management, *Meditterranean Sea, *France.

The French Ministry of Health set up a program in 1972 to monitor water quality in public areas along the Mediterranean Sea. During the high use season water samples are taken once a week. The samples are analyzed for: total coliforms, fecal coliforms, and fecal streptococci. If water quality is not satisfactory, measures taken include improvement of

sewage installations and closing of the contaminated beach areas. All water quality results are analyzed at the close of the summer season. This analysis indicates what areas are subject to pollution and many cause changes in the sanitary policies of nearby towns. During the 1978 summer season, 515 sample points were followed up using 500 samples. Data collected are presented. (Small-FRC)
W83-03515

RESULTS OF LAKE CLEANUP IN THE ORDER-HAVEL CATCHMENT AREAS (ERGEBNISSE DER SEESANIERUNG AUS DEM EINZUGSGEBIET DER WWD ORDER-HAVEL),
Wasserwirtschaftsdirektion Oder Havel, Potsdam (German D.R.).
H. Schmidt, and E. Rohde.
Wasserwirtschaft-Wassertechnik, Vol 32, No 8, p 280-282, 1982. 2 Fig, 5 Ref.

Descriptors: Water management, *Planning, Pollution, Seawater, *Water quality control, Metropolitan water management, Eutrophication, Longterm planning, Algae, Water depth, Water treatment, Ecosystems, Ecological effects, *Federal Republic of Germany, Oder-Havel catchment.

Experiences with cleaning up lake waters in the Order-Havel district are recounted. Eutrophication, evidenced by increased concentrations of aquatic plants and algae, is the greatest problem of the water bodies in this district. From 1976 to 1980, 11 bodies of water were cleaned up, and plans exist to clean at least 16 others. In shallow takes dredging was the main method employed; this increased the navigability, removed obstructions to flow, and improved land values, fisheries and transport. (Titus-FRC)
W83-03516

ADMINISTRATIVE COORDINATION IN THE IMPLEMENTATION OF AGRICULTURAL NONPOINT POLLUTION CONTROLS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6E.
W83-03559

USE OF FERRUGINOUS GROUNDWATERS TO AUGMENT STREAMFLOW,
H. A. C. Montgomery.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 5, p 343-351, September, 1982. 3 Tab, 10 Ref.

Descriptors: *Groundwater, Water supply development, *Iron compounds, Water quality, Streamflow, Rivers, Boreholes, Catchments, Legal aspects, Reservoirs, *Low flow augmentation, Water quality management, *Flow augmentation.

The water quality implications of low flow augmentation at sites where the groundwater contains iron are described. In a typical low-flow augmentation scheme several small boreholes are used in the upper catchment, each with a low yield in the range 1-5 Ml/d, giving in aggragate a valuable increase in flow at a downstream abstraction point. In some circumstances the increased flow is beneficial to fish and other aquatic life. Normally, augmentation would only be used for periods of a few weeks or months, and by no means every year. As the water is only pumped when needed, operating costs are minimized and full use is made of naturally available river flows. Local investigations revealed certain minor streams on the Isle of Wight, containing on the order of 3-6 mg iron/liter and severely affected by unsightly ferruginous deposits and iron bacteria. Low-flow augmentation by ferruginous groundwaters is likely to have adverse effects on fish spawning grounds, benthic invertebrates, stream flora, and the appearance of streams. Although the legal procedures are tedious, such discharges should be controlled by normal consent procedures. For discharges to streams classified under the National Water Council (NWC) system, maximum permissibile concentrations of iron can be calculated for each proposed augmentation discharge based on the river quality standards (RQS) downstream. Relevant factors in the calculations are the concentrations of iron in the discharge and the stream, the ratio of the flow rate of the discharge to the appropriate low flow of the stream, and in some cases the rate of deposition of iron, which should be found by experiment. Control is recommended such that the iron does not exceed 2 mg/liter in Class 1A streams and 3 mg/liter in Class 1B streams. Individual limits should be set for unclassified streams, depending on the legitimate uses. (Baker-FRC)
W83-03577

A METHOD TO COMPUTE RIVER HEATING - APPLICATION TO THE MANAGEMENT OF THERMAL LOADINGS TO THE RHINE RIVER (UNE METHODE DE CALCUL DE L'ECHAUFFEMENT DES RIVIERES - APPLICATION A LA GESTION DES REJETS THEMIQUES AU RHIN),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
M. Poulin, and P. Hubert.
Journal of Hydrology, Vol 55, No 1/4, p 195-211, 1982. 8 Fig, 2 Tab, 7 Ref.

Descriptors: *Thermal pollution, *Heated water, Mathematical studies, Rivers, *Mathematical models, Waste heat, Thermal powerplants, Powerplants, Cooling water, Industrial water, Flow rate, Water temperature, Wind velocity, Rhine River, *Federal Republic of Germany.

The newly introduced concept, especially for administrative purposes, of increases in river temperature due to thermal discharges produced a need for convenient computational methods. A method is presented which computes the river mean excess temperature with a daily time-step for several monitoring stations. The only data used are the values of thermal loadings, river flow rate, water temperature, and wind speed. In a case study, the error was less than 20%. The method was used to design a management model for a set of thermal power stations cooled by a river which is subject to temperatures in excess of standards. This model was then applied to the Rhine River. (Author's abstract)
W83-03584

AN INSTITUTIONAL PERSPECTIVE ON THE USE OF NATURAL RESOURCES AND THE IRRIGATION AND NITRATE CONTAMINATION PROBLEM,
Wisconsin Univ.-Madison. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W83-03587

ENGINEERING AND LEGAL RAMIFICATIONS OF GROUNDWATER CONTAMINATION - A CASE STUDY,
Dufresne-Henry, Inc., Concord, MA.
G. R. Allan.
Journal of the New England Water Works Association, Vol 96, No 4, p 329-336, December, 1982. 2 Fig.

Descriptors: *Groundwater pollution, *Legal aspects, *Water pollution control, Water pollution sources, Water supply, Case studies, Groveland, *Massachusetts, Trichloroethylene, Solvents, Organic compounds, Interceptor wells.

A case study is presented of how one town in Massachusetts reacted to the loss of its entire water supply due to contamination by trichloroethylene (TCE). To meet its water supply demands, Groveland received emergency water through existing connections with Haverhill and Georgetown. The town received a $157,000 grant from HUD under the Imminent Threat to Public Health and Safety Program to construct another well and pumping station. A Special Town Meeting was held to investigate the source, direction and possible treatment of the water supply. The field phase of the suggested program consisted of installing 2.5 inch test wells in strategic locations to determine groundwater levels and to sample for contamination. A seismic survey was also used to determine depth to bedrock. A total of 37 water samples was taken and tested for 12 volatile organic compounds. Two separate pollution sources were identified, and in each case a specific polluter was identified. To restore the acquifer to conditions where one or both wells could be reactivated, the use of interceptor wells was proposed as the first step. A deep well turbine pump would be used to discharge the water to a man-made lagoon, where artificial aeration would be introduced. From the lagoon the water would be discharged to a nearby brook. The basis for this program is the volatile nature of the organic contaminants. It is suggested that such interceptor wells are an inexpensive restoration technique. (Baker-FRC)
W83-03626

SOURCE PROTECTION - AN OUNCE OF PREVENTION,
Dufresne-Henry, Inc., North Springfield, VT. Solid Waste Dept.
J. A. Dohrman.
Journal of the New England Water Works Association, Vol 96, No 4, p 322-328, December, 1982. 2 Fig.

Descriptors: *Groundwater management, *Protection, *Aquifers, *Vermont, *Massachusetts, Planning, Management, Drinking water, Water quality, Case studies.

An aquifer assessment report is provided which presents the groundwork from which a source protection plan can be developed for a particular town. Both of the towns considered in this report are at present formulating local zoning changes and implementing the other recommendations as contained in this report. Any source protection plan must be preceded by a definition of the source recharge area and an evaluation of existing and proposed land use. An aquifer assessment study contains two basic components, a hydrogeologic study to define the geologic setting and recharge limits, and a land use evaluation of existing and proposed land use activities. The first assessment is for Middlebury, Vermont, where the initial concern was a crop dusting operation at the airport. The hydrogeologic study included a two-phase subsurface evaluation, with goals aimed at defining the origin of the sand and gravel making up the aquifer, determining the approximate extent of the upper clay layers, and locating the recharge area boundary in the direction of the airport. The second assessment was made for the town of Sunderland, Massachusetts. The aquifer was a classic delta formation of highly permeable sand and gravel and had been fairly well documented in several previous geology reports. The town was primarily concerned about several proposed developments within the delta area. (Baker-FRC)
W83-03627

GROUNDWATER PROTECTION ON THE LOCAL LEVEL: INTEGRATING THE FRAGMENTS OF REGULATION,
J. K. Chanoux.
Journal of the New England Water Works Association, Vol 96, No 4, p 310-321, December, 1982.

Descriptors: *Groundwater management, *Legal aspects, Groundwater contamination, Drinking water supplies, Concord, *Massachusetts, Water quality, Groundwater, Watershed protection, Case studies.

The development and implementation of the land use regulatory phase of a ground water protection program on the municipal level are described. The particular approach which a community adopts for the protection of groundwater should reflect that community's goals, needs and resource characteristics. Alternative approaches should be presented and considered. The extent of municipal power to regulate land use for the protection of groundwater is considered with special emphasis on police power, reasonableness of objectives regarding groundwater protection, reasonableness of means, and enabling legislation. Management op-

tions include traditional zoning, performance zoning, subdivision regulations, health regulations, wetland protection, erosion and sedimentation, and general groundwater protection law. The need for local regulatory programs to protect groundwater is derived from the essentially public character of this resource. The right of a municipality to interfere in the private use of property in order to promote the public interest is grounded in its police powers. Groundwater protection may be legislated on the local level through various means. A comprehensive implementation program to protect groundwater resources in Concord, Massachusetts, is described in depth. (Baker-FRC)
W83-03628

RESERVOIR EUTROPHICATION AND MANAGEMENT,
Lycott Environmental Research, Inc., Southbridge, MA.
L. Lyman.
Journal of the New England Water Works Association, Vol 96, No 4, p 353-360, December, 1982.

Descriptors: *Water quality control, *Reservoirs, *Eutrophication, Algal growth, Organic material, Lakes, Ponds, Drinking water, Water quality.

6

Whenever a new reservoir is constructed, it will go through a period of stabilization. Problems encountered in management of a reservoir include the fact that in many instances the water must continue to be used for public consumption while still trying to manage a long-term eutrophic body of water. It is recommended that any water department or district that has a reservoir associated with its supply should evaluate its reservoir in relationship to the eutrophic scale. Once the rate of eutrophication has been established for the reservoir in question, the next step is to begin long term corrective measures. Most such measured deal with land use, e.g., the restriction of roadway and highway construction and use, together with development of residential, agricultural, and industrial lands. With accelerated eutrophication, various water quality problems arise. These can include periodic algae blooms, reduction of transparency and degradation of color, increased bacterial growth, and increased sodium content. Aeration is a technique which has been employed for the past 10-12 years by various water departments to manage the production of algae and control hydrogen sulfide, produced at the bottom or in the hypolimnic region of deep reservoirs. Dredging should be the last resort for any body of water in that it disrupts the chemical, biological, and fisheries systems more extensively than dredging of the sediments. Other control measures include physical sealing of vegetative growth, weed harvesting, and chemical management. (Baker-FRC)
W83-03629

MANAGING THE RISK AND LIABILITY OF TOXIC CONTAMINATION OF WATER SUPPLY,
Geomet Technologies, Inc., Rockville, MD.
For primary bibliographic entry see Field 6F.
W83-03630

HERE COMES THE WATER BUBBLE--MAYBE,
K. C. Flynn.
Journal of the Water Pollution Control Federation, Vol 55, No 2, p 116-118, February, 1983.

Descriptors: *Standards, *Effluent limitations, *Water pollution control, *Bubble concept, Air pollution, Regulations, Pulp and paper industry, Fox River, *Wisconsin, Industrial wastewater, Wastewater disposal, Pollution load.

The bubble concept, sometimes applied in air pollution control, has not been widely applied to water pollution control. However, this approach is being successfully used to regulate discharges from a complex of 14 pulp and paper mills crowded within 20 miles of the Fox River, Wisconsin. Factors which make the bubble approach work here are the concentration of many mills into a small area and the nature of the stream, which is small and subject to seasonal low flows. During low flow conditions some pulp mills shut down some operations to preserve water quality of the stream. The only true national bubble in water pollution control is in the steel industry. It allows plants with multiple wastewater discharge outfalls to exceed the effluent limit for a pollutant at one outlet if there is an offsetting reduction at another point. A similar policy, although not a true bubble policy, in the petroleum industry and pulp and paper industry allows a single limitation per plant. It is not expected that the bubble approach can be economically applied to any other industries at this time, partly because industries in a given watershed are often diversified. Problems in applying the bubble concept to water include difficulties in the legal definition of pollutant sources, complicated standards, the wider latitude states have in enforcing water standards as compared with air standards, problems in measuring nonpoint source pollution, inadequate areawide planning, and greater concentration of pollutants in water than in air. (Cassar-FRC)
W83-03634

CHANGING THE CLEAN WATER ACT: REFLECTIONS ON THE LONG-TERM.
For primary bibliographic entry see Field 6E.
W83-03635

INTEGRATION OF MANAGEMENT METHODS WITH THE LIFE CYCLE AND ECOLOGY OF THE FILAMENTOUS ALGA, PITHOPHORA,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 4A.
W83-03680

THE ESTIMATION AND APPLICATION OF THE DEMAND FOR DISCHARGE WITHIN THE CONTEXT OF WATER QUALITY MANAGEMENT SYSTEMS,
Clemson Univ., SC. Dept. of Economics.
For primary bibliographic entry see Field 6F.
W83-03701

ENVIRONMENTAL QUALITY STANDARDS--NEW PROBLEMS FOR THE ANALYST,
For primary bibliographic entry see Field 5A.
W83-03798

CACO3 NEUTRALIZATION OF ACIDIFIED SURFACE WATERS,
Syracuse Univ., NY. Dept. of Civil Engineering.
C. T. Driscoll, J. R. White, G. C. Schafran, and J. D. Rendall.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1128-1145, December, 1982. 10 Fig, 2 Tab, 34 Ref.

Descriptors: *Acidic water, *Water quality control, *Neutralization, *Lake sediments, *Detritus, Theoretical analysis, Acid streams, Acidity, Chemical properties, Lime, Organic matter, Model studies, Calcium carbonate, *New York, Big Moose Lake.

Field studies were carried out to compute the theoretical base requirements for the neutralization of an acidified aquatic system, examine the feasibility of using calcium carbonate as a neutralizing agent, and assess the water quality changes associated with calcium carbonate. Theoretical calculations based on aqueous base neutralizing capacity underestimated the calcium carbonate dose required to achieve lake neutralization (pH 6.5) in Big Moose Lake in the Adirondacks of New York for one year. Results indicated that lake sediments greatly influence base dose requirements, especially if much organic detritus is present. Neutralization with calcium carbonate altered water column pH, calcium, acid neutralizing capacity, dissolved inorganic carbon, dissolved organic carbon, free fluoride, aluminum, manganese, zinc, and copper levels. Chemical equilibrium models aided in predicting changes in aqueous aluminum chemistry. However, limestone barriers do not appear to be a feasible means for neutralization of lake acidity. The deposition (fouling) of hydrolyzing metals and organic detritus within the barrier represents a significant operational problem. (Geiger-FRC)
W83-03834

MATHEMATICAL MODEL FOR MANAGEMENT OF WATER QUALITY IN RIVERS: APPLICATION TO THE YAMASKA RIVER (MODELE MATHEMATIQUE DE GESTION DE LA QUALITE DE L'EAU EN RIVIERE: APPLICATION A LA RIVIERE YAMASKA),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
M. Pineau, J. P. Villeneuve, and P. G. C. Campbell.
Canadian Journal of Civil Engineering, Vol 9, No 4, p 573-585, December, 1982. 3 Fig, 11 Tab, 31 Ref.

Descriptors: *Pollution load, *Phosphorus, *Water quality standards, Model studies, Mathematical models, Yamaska River, *Quebec, Wastewater treatment, Nonpoint pollution sources, Agricultural runoff, Nutrients, Water quality control.

A simple mathematical model was developed for identifying the optimal strategies for controlling nutrient loadings, particularly phosphorus, to a river basin. The objective of the optimization was to maintain phosphorus concentrations at 0.06 mg per liter or less at minimum costs. The model was applied to a study of the 4911 sq km Yamaska River basin, Quebec, where nutrient loadings from municipal, industrial, and agricultural sources are excessive. Allowable pollutant loads were calculated for each of 7 towns to achieve the specified goals for phosphorus levels in the river. (Cassar-FRC)
W83-03839

THE COMPREHENSIVE WATER QUALITY MANAGEMENT PROGRAM FOR THE LAGUNA DE BAY IN THE PHILIPPINES,
Laguna Lake Development Authority, Manila (Philippines). Environmental Protection Div.
J. D. Centeno, and B. L. Adan.
Water Supply and Management, Vol 6, No 6, p 557-565, 1982. 4 Fig, 2 Tab, 3 Ref.

Descriptors: *Water quality control, *Developing countries, *Philippines, Laguna de Bay, Water management, Water pollution control, Model studies, Planning, Financial aspects.

The Laguna de Bay is the largest freshwater lake in Southeast Asia; the uses of its resources include irrigation, fishery and public water supply. The comprehensive water quality management program and strategies adopted by the Laguna Lake Development Authority for proper abatement of water pollution in the Laguna Lake are outlined. A review of the main sources affecting the water quality of the lake provided guidance in the formulation of the water quality management program. The focus of the program is to control various sources of water pollution and minimize or prevent spread of diseases, thus improving the health and economy of the area. Major pollution sources were from the human population, agricultural and industrial activities, and in a small proportion from fallout within the basin and the recurring Pasig River backflow which brings saline water into the lake. The program calls for application of administrative measures, including preparation and enforcement of rules and regulations to implement the program, monitoring of lake and tributary river water quality for assessment of effectiveness of pollution control measures, implementation of pollution reduction measures directed to the control of the various pollution sources, continuation of researchers on the limiting factors of eutrophication, implementation of demonstration projects and the operationalization of the ecological model as a tool for decision making. (Baker-FRC)
W83-03843

STRATEGIES FOR WATER QUALITY MANAGEMENT IN THE CHAO PHRAYA RIVER IN THAILAND,
Asian Inst. of Tech., Bangkok (Thailand).
B. N. Lohani, and M. S. Mya.
Water Supply and Management, Vol 6, No 6, p 521-543, 1982. 11 Fig, 3 Tab, 5 Ref.

Descriptors: *Water quality control, *Planning, Developing countries, *Thailand, Water management, Water pollution control, Water quality, Reservoir releases, Reservoir operation, Flow augmentation.

A finite element substance dispersion model is formulated and applied for determining effluent standards and degree of waste water treatment levels so as to maintain BOD5 and DO levels in the Chao Phraya river, as stated in the Stream Standards. The mangement policies studied are specifying degree of waste water treatment, setting effluent standards and determining reservoir operating policies. Six quality policies were studied with the help of the model to examine the appropriate policy that will provide a desired level of DO and BOD in the river. Different effluent standards for BOD5 were studied to determine the most appropriate standard. It was noted that setting effluent BOD5 at a maximum of 60 mg/l with minimum flow rate of 100 cubic m/sec would be a suitable control measure. Flow augmentation was also studied to determine the additional flow of water to be released from the upstream reservoir at the Chao Phraya dam to the extent that the water quality in the river will be maintained at the desired level for 95% of the time. It was concluded that a release of 20 cubic m/sec of additional flow in excess of the present level of reservoir operation was needed to achieve the stream standards. (Baker-FRC)
W83-03845

RECENT DEVELOPMENTS ON STOCHASTIC PROGRAMMING MODEL FOR WATER QUALITY MANAGEMENT,
Asian Inst. of Tech., Bangkok (Thailand).
B. N. Lohani, and A. R. Saleemi.
Water Supply and Management, Vol 6,No 6, p 511-520, 1982. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Model studies, *Water quality control, Rivers, Developing countries, Stochastic process, Mathematical studies, Dissolved oxygen, Water pollution control.

A stochastic programming model for regional water quality management in rivers has been developed which incorporates all the water quality parameters as stochastic entities and thus provides a more realistic formulation than earlier models. For the formulation of a model for water quality management under stochastic environment, a stream on which there are n wastewater discharge sources is considered. The river is divided into n reaches, each reach being between two waste water discharge points. The treatment system at any discharge source includes waste flow rate and the initial BOD content in the waste water, which are both random parameters and can be represented by a known probability density function. The stream is considered as an integral part of the system, and BOD removal required at each discharge point depends on the assimilative capacity of the stream. Flows in stream reaches are considered as random variables, and thus they are known only with a certain probability of occurrence. Further, the deoxygenation and reaeration coefficients in the river are also considered as stochastic variables and hence occur with a certain probability. The stochastic programming model as presented was applied to the Hsintein River in Taiwan. Findings demonstrate this model to be superior to the earlier model of Lohani and Thanh. (Baker-FRC)
W83-03846

MODELLING A RIVER WATER QUALITY SYSTEM: A CASE STUDY OF TANSHUI RIVER IN TAIWAN,
Asian Inst. of Tech., Bangkok (Thailand).
B. N. Lohani, and F. C. Yang.
Water Supply and Management, Vol 6, No 6, p 487-509, 1982. 16 Fig, 8 Tab, 8 Ref.

Descriptors: *Model studies, *Water quality, *Rivers, Water pollution control, *Taiwan, Tanshui River, Biochemical oxygen demand, Dissolved oxygen.

A mathematical model for simulating BOD and DO in the Tanshui River Basin in Taiwan is presented. An optimization model was also formulated to examine appropriate water pollution control policies for the Tanshui River Basin. Results gained from the DO-BOD model were then compared with the observed values. Optimal waste water loadings to maintain a desired DO value in the Tanshui River were also specified. While close correlation was found between model findings and experimental results in most cases, slight discrepancies occurred at the river mouth due to the non-inclusion in the model of some parameters to quantify the effect of tidal conditions. Through use of the model study DO standards for different reaches of the basin have been recommended. Waste discharges along the river can be adjusted through the application of management stragtegies such as waste water treatment, artificial reaeration, waste withholding, and others, so as to maintain a specified standard in a river using the approach of the optimization model developed. Water quality in the upstream and midstream reaches for all the area is still above the recommended standards. However, for downstream reaches the observed DO levels for Hsintien, Keelung, and Tanshui Rivers are below the standard levels. Basinwide pollution control strategies are needed to help improve the Tanshui River quality. (Baker-FRC)
W83-03847

ESTABLISHING WATER QUALITY OBJECTIVES AND EMISSION TARGETS IN RIVERS,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
B. N. Lohani.
Water Supply and Management, Vol 6, No 6, p 469-485, 1982. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Water quality control, *Water management, *Developing countries, Tropical Regions, *Asia, Planning, Water pollution control, Management, Decision making.

Essentials of water quality objectives and emission targets are outlined, and the rational water quality objectives are examined for several water uses for tropical countries, particularly the developing countries in Asia. Different management approaches are available for establishing water quality objectives, each with its own peculiar advantages and disadvantages depending on the area of study. However, the final goal of each method is the protection of natural water resources for their contemplated best usage. The establishment of water quality objectives and emission targets provides a more rational mechanism for achieving water quality at the desired level for the controlling use at minimum cost to an Asian country. It provides for flexibility in the adoption of methods for pollution control and abatement while at the same time placing the primary emphasis where it should be, on the receiving stream. Use of this approach requires a thorough knowledge of stream conditions and uses, which can be obtained only through exhaustive and time consuming studies. This indicates a strong, well staffed, and adequately financed water pollution control agency which is so closely associated with local problems as to permit adjustments in the classifications and objectives in keeping with changing stream conditions and water requirements. (Baker-FRC)
W83-03848

WATER QUALITY MANAGEMENT IN ASIA: BASIC ISSUES AND PRIORITIES,
Asian Inst. of Tech., Bangkok (Thailand).
B. N. Lohani.
Water Supply and Management, Vol 6, No 6, p 465-468, 1982.

Descriptors: *Water quality, *Developing countries, Planning, Water management, Monitoring, Cost analysis, Financial aspects, Water quality control, Water demand, *Asia.

In the majority of developing countries water pollution is perhaps a first priority issue, followed by solid waste and air pollution issues. Water quality management is often described as an organized effort to maintain or improve the ambient water quality against the waste water loads such that the beneficial use of water is not adversely affected by exercising a suitable control. Four major questions are presented: assessment of the water quality, assessment of water quality criteria, assessment of water quality impacts, and assessment of strategies for control. Assessment of water quality calls for a monitoring program with a great number of sampling stations and high frequency. A further factor of concern is the number of parameters to be measured which would adequately describe the water quality. Water quality criteria are often related to water use and are determined based on the nature of use quality relationships. Assessment of strategy control must consider a number of technological alternatives of water quality control at a time, take advantage of economies of scale, and find administratively more efficient methods. Water quality management forms one of the important objectives in the management of overall environmental quality, at least for some time, in the case of developing countries. (Baker-FRC)
W83-03849

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

GENERATING ALTERNATIVE SOLUTIONS FOR DYNAMIC PROGRAMMING MODELS OF WATER RESOURCES PROBLEMS,
Illinois Univ. at Urbana-Champaign. Dept. of Landscape Architecture, Urban, and Regional Planning.
L. D. Hopkins, E. D. Brill, Jr., and B. Wong.
Water Resources Research, Vol 18, No 4, p 782-790, August, 1982. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Flood plain management, *Alternative planning, *Dynamic programming, Land use, Model studies, Hickory Creek watershed, *Illinois, Planning, Water management, Weighted difference method.

The MGA (Modeling to Generate Alternatives) technique was proposed as a method for improving the application of optimum-seeking models. The intent of MGA is to generate sets of alternatives that are as different from each other as possible but are feasible given the physical structure of the system of concern and good with respect to target values for well-understood objectives. The approach will permit the decision maker to bring to bear his implicit knowledge of the problem, which could not be incorporated into the model. Three dynamic programming methods which differ in the procedure for identifying different alternatives are considered: adapting the kth best policy method based on a difference constraint, generalizing the preceding method by treating difference and the known objective as two components to be weighted, and searching a modified traceback for solutions of maximum difference. The second approach apparently has operational and conceptual advantages. The application of the weighted difference dynamic programming algorithm to the generation of alternatives was illustrated on the basis of a floodplain management model for the Hickory Creek Watershed in Illinois. In the Model, the watershed is divided into subbasins, each of which is associated with a reach of the stream. Possible land uses are defined with respect to hydrologic characteristics and economic rent. A dynamic programming algorithm can then be used to find the assignment of land uses to subbasins that maximizes economic rent to land for the entire watershed, while accounting for flood damages. Five alternative land use patterns were generated, giving economic rents within 2.4-7.7% of the original solution, and presenting a range of policy options for the decision maker. (Cassar-FRC)
W83-03580

A RIVER BASIN NETWORK MODEL FOR CONJUNCTIVE USE OF SURFACE AND GROUNDWATER: PROGRAM CONSIM,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. W. Labadie, S. Phamwon, and R. C. Lazaro.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235291, Price codes: A07 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report No 125, Colorado State University, Fort Collins, June 1983. 134 p, 30 Fig, 6 Tab, 40 Ref. OWRT B-201-COLO(5), 14-34-0001-9061.

Descriptors: *River basins, *Simulation, *Optimization, Groundwater, *Conjunctive use, *Reservoir operation, *Computer programs, Model studies, Program CONSIM.

A generalized planning model has been constructed which simulates the dynamics of a complex river basin system. This model uses a network approach which is capable of modeling systems with a large-scale and complex water storage, transport, and distribution morphology. The model, called Program CONSIM, is also capable of considering stream-aquifer interaction, including the effects of pumping and artificial recharge on a monthly or weekly basis. Potential evaporation is computed directly in the model by the Blaney-Criddle method, but other methods can be selected by the user and input as demands in the model. Complex institutional factors such as formal water rights and informal exchange agreements can also be considered. The model as designed can be used for locating and sizing new facilities (e.g., reservoirs), impacts of transfer of water rights, incorporating new demands for energy development, instream uses, transbasin diversions, conjunctive use of surface and groundwater, and contingency planning for potential drought periods. The computer model has been especially designed to be interactive and conversational for ease of use by planners and managers.
W83-03596

STATED FINANCING POLICIES OF GOVERNMENT AGENCIES AND THE EXPERIENCE OF RURAL WATER SUPPLY SYSTEMS,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agricultural Economics.
R. Vaidya, and D. J. Allee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235481, Price codes: A04 in paper copy, A01 in microfiche. Center for Environmental Research Completion Report, Ithaca, NY, July 1983. 49 p, 13 Tab, 9 Ref. OWRT-A-094-NY(1), 14-34-0001-1134.

Descriptors: *Water supply, *Community development, *Rural development, Public finance, Construction industry, Regression analysis, Government finance, Water policy.

A national data base of 800 water systems was used to match the stated policies of various public funding agencies (Farmers' Home Administration, Economic Development Administration, Housing and Urban Development) to the experience of their customers. The sample was representative of all rural water users in the nation. Regression analysis was used to match the experience of local communities with the stated policies. The results for the FHA serve as an example and are important because they have been the largest provider of public funds to systems serving rural people. For example, the stated policies of FMHA is to award grants or loans up to a fixed percentage of project cost; the results show that how much a water system gets does depend on how much it needs. The division of assistance between loans and grants varies with number of connections--the more connections, the larger share funded by loans. This is a direct result of interaction between the FHA policies known as the '1% rule' and the differences in income by size of community. The stated policy is to give priority to nonprofit systems with no stated difference between public and private. The results indicated that public systems have acquired larger grants but private nonprofit systems have been favored in terms of total numbers.
W83-03606

6B. Evaluation Process

DREDGED SEDIMENT FOR AGRICULTURE: LAKE PARADISE, MATTOON, ILLINOIS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W83-03558

AN INSTITUTIONAL PERSPECTIVE ON THE USE OF NATURAL RESOURCES AND THE IRRIGATION AND NITRATE CONTAMINATION PROBLEM,
Wisconsin Univ.-Madison. Dept. of Agricultural Economics.
D. W. Bromley, and R. C. Griffin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235218, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center Publications No WIS WRC 83-06, Univ. of Wisconsin, Madison, 1983. 49 p, 2 Fig, 1 Tab, 78 Ref. OWRT A-085-WIS(1), 14-34-0001-0153.

Descriptors: *Agricultural runoff, *Economic aspects, *Irrigation, *Natural resources, *Nonpoint pollution sources, Agricultural chemicals, Beneficial use, *Nitrates, Policy making, *Wisconsin, Central Sands area.

Cognizance of the nonpoint nature of many forms of agricultural pollution renders traditional pollution policies depend on the ability to identify the individual externality contributions of each economic agent. This fact has clouded the search for economically efficient programs for confronting instances of agricultural pollution and may have led to the institution of policies without sufficient attention to economic consequences. Discussions are provided of the consequences not including relationships or models performing as nonpoint production functions in economic analyses of agricultural runoff. It was noted that the Universal Soil Loss Equation has been used to obtain simultaneous economic and environmental modeling, but some deficencies in this type of analysis are still present. Present policy for agricultural runoff focuses on the concept of 'best management policies,' but several failures of this policy have been isolated. A second section of this report deals with fundamental economic questions of natural resources use, namely, who controls the institutions that allocate natural resources, who receives the benefits from particular use patterns and who is exposed to the costs arising from the use of natural resources. The third portion of the report is a layperson's discussion of the impacts of irrigation on nitrate contamination problem. The site of the study is the Central Sands area of Wisconsin. An outline is provided of the options of policymakers for solving this problem together with a discussion of the ramifications of each option.
W83-03587

ANALYSIS OF CRITICAL WATER PROBLEMS IN THE NORTHEASTERN UNITED STATES TO DETERMINE ESSENTIAL RESEARCH REQUIREMENTS,
Rhode Island Univ., Kingston. Water Resources Center.
D. W. Urish.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235267, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 15, June 1983. 96 p, 6 Append. OWRT B-061-RI(5), 14-31-0001-3953.

Descriptors: *Research needs, *Research priorities, Wastewater managment, Flood damage, River basin development, Acid mine water, Sewage disposal, Northeast U.S., New England, *Water Research Institutes.

This project was a research planning endeavor and was regional in scope involving 15 Water Resources Centers or Institutes. The following objectives were pursued: 1. To develop an effective procedure for identifying research needs as they relate to critical water resource problems in the Northeast Region. 2. To seek participation by a broad spectrum of individuals and institutions in the Northeastern States confronted with water resource problems in order to assign priorities to these problems. 3. To facilitate the transfer of knowledge between the universities and public decision makers on the basis of collaboration and thus to lay the groundwork for effective technology transfer. 4. To make optimum use of available research funds through multiple university research cooperation. Six workshop conferences were held: Specific areas covered in workshops were: recycling urban wastewater on land, procedures for water research proposal review, river management needs, non-structural alternatives in flood damage abatement, acid mine water, and on-site treatment of domestic wastes. The published proceedings of these workshops identify critical research needs and provide guidance in research program development for both state and regional interests.
W83-03592

EVALUATION OF ALTERNATIVE PROCEDURES FOR REVIEW OF WATER RESOURCES RESEARCH PROPOSALS,
Massachusetts Univ., Amherst. Water Resources Research Center.
For primary bibliographic entry see Field 9D.
W83-03600

RIVER MANAGEMENT RESEARCH NEEDS,
Connecticut Univ., Storrs. Inst. of Water Resources.
V. E. Scottron.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235333, Price codes: A06 in paper copy, A01 in microfiche. In: Proceedings, Workshop, University of Connecticut, March 11-12, 1976. Storrs, 15 p, 18 Ref. OWRT B-061-RI(6), 14-31-0001-3953.

Descriptors: *Research needs, *Research priorities, *Reservoir management, River Basins, River flow, River regulations, River systems.

River management research needs were discussed in detail at a series of workshops held at the University of Connecticut on March 11 and 12, 1976. There were 51 participants from the various states in Northeastern United States. There were three basic workshops covering the following topics: Case studies in River Modeling, Distinction Between Research and Management, Locational Needs for Research Institutions, Transferability of Research Data Between River Systems, and Effectiveness of Regional Collaborations. The following conclusions developed from workshop discussions: (1) The overlapping jurisdictions of regulatory bodies clearly offer a researchable area for the political scientist, (2) There exists a serious need for agencies to cooperate in the selection of data to make it more significant, (3) There is a need for a regional institution with explicit responsibility for encouragement and management of river-related research.
W83-03601

ECONOMIC RESEARCH NEEDS RELEVANT TO IMPROVED DRINKING WATER QUALITY,
Resources for the Future, Inc., Washington, DC.
C. S. Russell.
Journal of the American Water Works Association, Vol 75, No 1, p 6-9, January, 1983. 12 Ref.

Descriptors: *Economic evaluation, *Cost-benefit analysis, *Public health, *Drinking water, *Policy making, Management planning, Econometrics, Cost analysis, Water quality, Decision making, Water policy, Potable water, Economic aspects, Water management.

In estimating the economic benefits of alternative public policies to ensure drinking water quality, the policy must be translated into levels of quality and total quantities of contaminants experienced by consumers (policy-to-dose), the levels of alternative tap water quality must be translated into effects on health, household appliances and aesthet-

ics (dose-response), and the predicted or measured effects must be valued in dollar terms to be compared with the costs of a given policy (response-valuation). The valuation of health is examined in terms of morbidity, mortality, aesthetic effects, and acute and chronic disease. There is an inadequate database covering the effects of water quality on human illness due to the lack of location-specific air quality measures, occupational exposure differentials, diet and smoking indicators, historic measures of variables, complications raised by systematic migration patterns, and uncertainty about the mechanism that translates exposure into disease. A special subcommittee of the Environmental Protection Agency has recommended that the dose-response area should receive the most attention during the next decade if substantial progress is to be made in dealing with questions of benefits. (Geiger-FRC)
W83-03637

RESEARCH NEEDS FOR WATER SUPPLY COST ESTIMATING,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
R. M. Clark.
Journal of the American Water Works Association, Vol 75, No 1, p 10-13, January, 1983. 69 Ref.

Descriptors: *Water management, *Water costs, *Decision making, *Future planning, *Research priorities, *Financing, Costs, Total costs, Cost analysis, Management planning, Prediction, Project planning.

There is a need for standard and consistent costing procedures in the management of water supply systems to evaluate project costs, compare expected costs of alternative measures, provide data needed to ascertain the economic burden of an abatement process on a specific plant or industry, predict pollution control costs, and gauge the cost-benefits of pollution control programs on society. The major research needs for water supply costing can be categorized as unit process cost estimating, water delivery cost, total systems management, and system financing. A special Environmental Protection Agency subcommittee has identified seven categories for possible research regarding unit process cost estimating, two major areas of research connected with water delivery costs, seven areas of research needed to supplement system financing. It is hoped that the identification of these specific research needs will aid the profession in establishing priorities for future research. (Geiger-FRC)
W83-03648

WATER AND ENERGY CONSERVATION IN IRRIGATED AGRICULTURE: AN ARID AREA TECHNOLOGICAL AND ECONOMIC CASE STUDY,
Arizona Univ., Tucson.
For primary bibliographic entry see Field 3F.
W83-03773

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

INQUIRY INTO TAX GAINS FOR MEMBERS OF PARTNERSHIPS (STEUERLICHE GEWINNERMITTLUNG BEI PARTNERWERKEN),
Nordostschweizerische Kraftwerke A.G., Baden.
F. J. Harder.
Wasser, Energie, Luft, Vol 73, No 3, p 51-52, March, 1981. 1 Fig. (No English Summary).

Descriptors: *Hydroelectric plants, *Taxes, *Cost sharing, *Economic aspects, *Regional development, Resources development, Construction costs, Operating costs, Total costs, Legal aspects, Cost allocation, *Switzerland, Hydroelectric power, Electric power costs, Electric power industry, Powerplants, Electric powerplants.

The accusation is addressed that the mountain cantons of Switzerland are being exploited by power station partnerships in that the partnerships are taking hydroelectric power from the cantons while giving too little in return. The cantons of Graubunden and Wallis, in particular, want to impose a tax upon the electric companies. It is pointed out that the hydroelectric power stations could not have been built without funds from the central plateau cantons, and that this arrangement has been mutually economically beneficial. During the construction period, industry and transportation in the area in which the powerplant is being built are stimulated. The power station partnership pays water taxes and duties during the 80 years that the power station is under its franchise (after this time it reverts to the canton) and must also donate a certain amount of energy to the canton and pay for new roads. The partnership is not formed for the sake of profit but to ensure adequate energy supplies at reasonable costs. It usually takes the form of a joint stock company in which the individual powerplant gives its energy to the partnership, which in return takes responsibility for the total costs of the powerplant. Thus risks are shared among the partners and breakdowns or other crisis situations in one station resulting in energy production losses can be covered by the other partners. Cantons and parishes examine the partnership contracts and ratify them; it must therefore be assumed that they have reviewed the sections concerning taxzes and have approved them. It is legally and economically impossible that hidden profit gains are being realized by power stations outside the production areas because of the joint-stock form of the partnership. Furthermore, energy produced at a reasonable cost benefits the consumer rather than tha partners. If the proposed tax is imposed, high energy costs will result. (Gish-FRC)
W83-03530

WATER PRICING RESEARCH NEEDS,
West Virginia Univ., Morgantown. Dept. of Economics.
P. C. Mann.
Journal of the American Water Works Association, Vol 75, No 1, p 24-27, January, 1983. 37 Ref.

Descriptors: *Pricing, *Research priorities, *Water costs, *User charges, *Reviews, Prices, Economic aspects, Water use, Costs, Future planning, Water management.

Traditionally, water rates are based on cost of service, with average prices for users and unavoidable price discrimination. While there is adequate information about rate structure alternatives, time-differentiated and conservational pricing and spatially differentiated or zonal pricing, there are gaps in knowledge on the actual effects of zonal or differentiated pricing, methodologies for applying alternative pricing methods, classification of consumer groups, and the effect of different kinds of water charges currently used by water utilities. Research is needed on the effects of innovative pricing, and the integration of cost of service with marginal cost pricing. Research is also needed on the causes of underpricing of water service, its short- and long-term effects, and alternative solutions to this problem. (Geiger-FRC)
W83-03649

EFFICIENT PRICING AND FINANCING OF URBAN WATER: THE ROLE OF DEVELOPMENT CHARGES,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. Pollock, and J. E. T. Moncur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246447, Price codes: A04 in paper copy, A01 in microfiche. Technical Memorandum Report No 69, June 1983. 53 p, 5 Fig, 5 Tab, 21 Ref.

Descriptors: *Prices, *Water costs, Development charges, Urban areas, Simulation models, Marginal costs, *Urban water, Hawaii, Washington, Oregon, California, Colorado.

Conventional methods of evaluating and designing urban water prices are deficient in several important respects. Urban water is underpriced substantially, due to undercosting which in turn results from failure to adjust accounting data for inflation; to recognize imputed costs, such as interest on equity capital; and to fully provide for rising real costs of source supply. Further, water users often cross-subsidize one another due to uniform 'postage stamp' pricing. This report uses data covering twelve Western U.S. urban water utilities to describe this undercosting and underpricing; describes a 'first-best' pricing paradigm based on real marginal cost; outlines a role and basis for calculating, development charges; and simulates their effects with a discrete non-stochastic simulation model.
W83-03689

THE FEASIBILITY OF ENGINEERING-ECONOMIC-MANAGEMENT ALTERNATIVES FOR MEETING WATER DEMANDS IN TUPELO-LEE COUNTY, MISSISSIPPI,
Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6D.
W83-03722

6D. Water Demand

GROWTH OF THE MUNICIPAL WATER SYSTEM IN CIUDAD JUAREZ, MEXICO,
Texas Univ. at Austin. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5F.
W83-03502

GROUNDWATER RESOURCES OF THE TEXAS RIO GRANDE BASIN,
Texas Univ. at Austin. Dept. of Environmental Health Engineering.
For primary bibliographic entry see Field 2F.
W83-03503

WATER-USE PRODUCTION FUNCTIONS OF SELECTED AGRONOMIC CROPS IN NORTHWESTERN NEW MEXICO, PHASE II,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2D.
W83-03560

RESEARCH NEEDS FOR CAPACITY PLANNING,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. T. Lauria.
Journal of the American Water Works Association, Vol 75, No 1, p 14-19, January, 1983. 40 Ref.

Descriptors: *Future planning, *Water supply development, *Water demand, *Capacity, *Model studies, *Research priorities, Water supply, Multipurpose reservoirs, Storage reservoirs, Water treatment facilities, Pumping plants, Water costs, Community development.

Capacity planning for water supply facilities includes consideration of not only size but also location and when to build. Demand plays an important role in capacity planning. Facilities are classified as single or multi-purpose units. Models and knowledge of capacity planning should also be classified according to the purpose of the system, its type, the state of its water demand and the responsiveness of demand to price. Components influencing capacity planning for major community water systems include supply reservoirs, pumping stations and treatment plants, transmission mains, distribution, networks and water storage tanks. Research needs for capacity planning as identified by a special Environmental Protection Agency subcommittee include applications, price-sensitive models, unified system design, network models, and uncertainty. Research needs in the area of uncertainty should address the categories of supply and demand, system failure, costs, standards, and technology. (Geiger-FRC)
W83-03639

A RESEARCH AGENDA FOR MUNICIPAL WATER DEMAND FORECASTING,

Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
J. J. Boland.
Journal of the American Water Works Association, Vol 75, No 1, p 20-23, January, 1983. 49 Ref.

Descriptors: *Water demand, *Future planning, *Forecasting, *Model studies, *Research priorities, *Water requirements, Projections, Water use, Decision making, Water management, Management planning, Prediction.

When making investment decisions for planning and managing water supply systems, the long-range forecasting of water demand is of utmost importance. Water demand forecasts can be categorized according to purpose or complexity of the water model used. Current forecasting practice usually relies solely on a single coefficient method, the per capita model. Multiple coefficient models have been applied in both aggregate and disaggregate forecasting. Demand models differ from requirement models in that they must possess a clear linkage to water use. Most demand models include weather-related variables when dealing with thhe residential sector. Research needs for the future should focus on creating demand models for users in multifamily residential structures or for nonresidential users. Further research is also needed to identify a more complete list of the variables that affect seasonal water use and to create fully probabilistic forecasting methods, especially where the cost of errors in forecasting is large. (Geiger-FRC)
W83-03640

SALINITY AND RESOURCE DEVELOPMENT PROBLEMS IN EAST KENT,
For primary bibliographic entry see Field 6G.
W83-03645

INCREASING ROCKPORT'S WATER SUPPLY,
Metcalf and Eddy, Inc., Boston, MA.
J. F. Shawcross, and D. Atkinson.
Journal of the New England Water Works Association, Vol 96, No 4, p 337-352, December, 1982. 5 Fig, 6 Tab.

Descriptors: *Water supply development, *Water demand, Rockport, *Massachusetts, Planning, Water management, Land use, *Water shortage, Alternative planning, Public opinion, Case studies.

The program which was used to identify and quantify new sources of water supply for the town of Rockport is reviewed. Some of the controversies surrounding the projects are described, and the program of emergency actions taken by the Town's engineering staff to continue the water supply until permanent new sources can be constructed is outlined. The shortage of water in Rockport results from the geological nature of the area, the growth of demand prior to 1979, and the inability of the community to overcome the complex problems existing in the time available. An emergency action program has prevented the town from running dry, but the situation is extremely precarious. There are undeveloped sources in the town which could provide adequate water through the year 2000. Development of these sources has been opposed by a variety of individuals and groups of interested people who for one reason or another feel that the development of one or more of the new sources is undesirable. The town is holding meetings to discuss various alternatives. It is hoped that actual construction will start late in 1982 and be completed by 1984, to include increasing the storage capacity of Cape Pond, developing permanent pumping facilities on Saw Mill Brook and Mill Brook, rehabilitation of the water treatment plant, additional storage tanks and new mains. As of September 18, 1981, a supply of 25 days of water was on hand. (Baker-FRC)
W83-03662

THE FEASIBILITY OF ENGINEERING-ECONOMIC-MANAGEMENT ALTERNATIVES FOR MEETING WATER DEMANDS IN TUPELO-LEE COUNTY, MISSISSIPPI,
Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
V. L. Zitta, R. L. Frnka, and W. McDonald.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249631, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, April 1983, 109 p, 7 Fig, 10 Tab, 48 Ref, 1 Append. A-136-MS(1), 14-34-0001-2126.

Descriptors: *Conjunctive use, *Water supply, *Water rates, Management, Linear programming, Planning, Groundwater, Surface water, *Mississippi, Tupelo-Lee County, *Water demand, Social aspects, Economic aspects, *Alternative planning.

The study provides a framework for assessing the feasibility of alternative water supply sources emphasizing allocation of costs in a given situation and provides a set of management criteria for determining a system of water pricing consistent with econmomic and social priorities in the Tupelo-Lee County Area in Mississippi. The solution approach utilized a linear programming technique where the objective function, consisting of cost coefficients for surface and well sources times the quantity of water used from each source, was minimized. This function was subject to both physical and water policy restraints where (1) all demands were met and (2) the demand from any one source did not exceed the supply. From a sampling of public water systems in the U. S., rank correlations between pricing systems and expressed objectives were computed in order to establish a basis for the selection of an efficient water rate structure.
W83-03722

SOME CURRENT PROBLEMS IN INVESTIGATIONS OF THE INTERACTION OF SUBSURFACE AND SURFACE WATERS OF THE USSR,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
G. V. Kulikov, and V. V. Kurennoi.
Water Resources (English Translation), Vol 9, No 2, p 144-148, March-April, 1982. 1 Tab. Translated from Vodnye Resursy, No 2, p 46-52, March-April, 1982.

Descriptors: *Subsurface water, Surface water, *USSR, Water transfer, Water resources, Water supply, Groundwater, Water supply development, Water demand, Conjunctive use, *Surface-groundwater relations.

Studies are being conducted in river valleys to characterize the interaction of subsurface and surface waters under river valleys. The principals of schematization of hydrogeological conditions have been developed. Typical drainage schemes have been compiled. Approximate parameters and the concept of zone of deformation of the subsurface flow have been introduced. Attempts have been made to classify this interaction of subsurface and surface waters. The proposed classification is based on isolating the leading genetic factors of the interaction of the waters and performing a general evaluation of the extent and conditions of manifestation of these factors and the character of the balance direction of the processes. It should be noted that the natural conditions of the territory of the USSR include each of the distinguished types and all factors of the interaction of natural waters. Although tidal, hydraulic, and technogenic factors are manifested under more specific conditions, the targets of the effects of these factors have been inadequately studied and classified. The difference between the tidal and hydraulic factors of interaction follows from the uniqueness of the nature of the energy involved, cosmic and hydrographic, and the directions of the processes, i.e., rhythmic, inflow-outflow, and outflow. The main tasks in studying the interaction of subsurface and surface waters should be regionalization of hydrogeological and hydrological conditions of the country by types of interaction and in investigation of its regularities, with consideration of landscape and climatic zonation. It is necessary to develop a spacetime prediction and in general a theory of monitoring the interrelation of subsurface waters and their control. (Baker-FRC)
W83-03734

WATER TRANSFERS FROM AGRICULTURE TO INDUSTRY: TWO UTAH EXAMPLES,
Utah State Univ., Logan. Inst. for Social Science Research on Natural Resources.
R. L. Little, and T. R. Greider.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-253336, Price codes: A08 in paper copy, A01 in microfiche. Research Monograph No 10, June 1983. 160 p, 1 Fig, 45 Tab, 74 Ref, 1 Append. OWRT A-050-UTAH(1), 14-34-0001-1147.

Descriptors: *Social impact, Social change, *Social adjustment, Water rights, Community development, Power plants, Irrigation, Utilities, *Utah, *Water transfer.

The large scale transfer of water usage from agriculture to industry transforms a farming to a mining or industrial based economy and brings major social change. In order to develop a better understanding of the process, data were collected between 1980 and 1982 on the social effects of transferring water from agriculture to power production in two areas of Utah: Millard County near Delta and Emery County around Castledale. Questionnaires were mailed to water sellers and nonsellers, and interviews were conducted with community leaders. The results indicate considerable variation between the two areas. Nevertheless, roughly half the water sellers in both areas were agriculturalists, and the vast majority were longtime residents. In spite of the new-found cash, most sellers intended on remaining in their communities. Few intended on investing in more efficient irrigation systems. The two areas differ dramatically in their satisfaction with the process for negotiating water sales. Where selling was a unified effort, there was little desire for alterations in the process should future transfers become necessary. Where the power company negotiated sales with individuals, there was a perceived need for controls on future negotiations. Both areas experienced dissension from the water sales. However, the differed in the focus of their hostilities. Communities satisfied with the sales process reported deep antagonisms, and the hostilities were personalized as values and expectations were violated. Communities dissatisfied with the sales process directed antagonisms toward the power company. Overt hostilities have declined, but covert hostilities remain. Changes in the community social structure appear to have occurred in both areas.
W83-03821

PREDICTING FUTURE WATER DEMAND,
Municipal Environmental Research Lab., Cincinnati, OH.
R. M. Clark, J. A. Goodrich, and J. I. Gillean.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1248-1264, December, 1982. 9 Fig, 11 Tab, 7 Ref.

Descriptors: *Case studies, *Water demand, *Urban areas, *Water supply development, *Future planning, *Population dynamics, Water use, Urban planning, Water supply, Wastewater facilities, Water treatment facilities, Water requirements, Prediction, *District of Columbia, Metropolitan Washington D. C.

The decentralization of metropolitan populations over the past few years has affected water supply planning, making it difficult to forecast future demands for water and wastewater services. A case study of the Metropolitan Washington, D. C. area was undertaken to illustrate a method for forecasting water requirements via data on spatial population density and per capita demands. The technique is based on the estimation of water use by demand sector and by location of demand according to population and employment growth patterns. The technique studies water use in terms of both residential and nonresidential demand and can demonstrate total demand, as well as demand location, peak requirements, average monthly demand quantities, and location of demand points. This information, when combined with extrapolated demand coefficients, can be used to forecast quan-

tity and location of demand to aid in water supply planning in urban areas. (Geiger-FRC)
W83-03835

DISPLACEMENT OF RECREATIONAL USERS BETWEEN THE LOWER ST. CROIX AND UPPER MISSISSIPPI RIVERS,
Clemson Univ., SC.
R. H. Becker.
Journal of Environmental Management, Vol 13, No 3, p 259-267, November, 1981. 2 Fig, 3 Tab, 22 Ref.

Descriptors: *Recreation, *Rivers, Decision making, Lower St. Croix River, Upper Mississippi River, Water management, Public opinion, Attitudes, Surveys, Social aspects, Water use, Water demand, Water quality requirements, Environmental quality.

Surveys of recreational use of the Lower St. Croix River and the Upper Mississippi River in 1977-78 revealed no relationship between user density and satisfaction on an individual basis. However, on a system basis it was observed that persons unhappy with the crowded conditions on the Lower St. Croix River changed their preference to the Mississippi. The Mississippi users as a group were more sensitive to user density than the Lower St. Croix group. During the summer of 1977 the Lower St. Croix River has 800,000 visitor days over 52 miles and the Upper Mississippi had 300,000 user days over 300+ miles. Persons seeking social recreation were inclined to visit the Lower St. Croix, and those prefering low density experiences, the Upper Mississippi. 'Water polluted', 'unsafe swimming', and 'litter and debris' were environmental quality indices selected as reasons for no longer visiting the Mississippi. (Cassar-FRC)
W83-03842

6E. Water Law and Institutions

PRINCIPLES FOR TRANSBOUNDARY GROUNDWATER POLLUTION CONTROL,
For primary bibliographic entry see Field 5G.
W83-03501

ADMINISTRATIVE COORDINATION IN THE IMPLEMENTATION OF AGRICULTURAL NONPOINT POLLUTION CONTROLS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
J. B. Braden, D. L. Uchtmann, and D. R. Prutton.
Illinois Water Resources Center Research Report No 171, August 1982. 72 p, 254 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Administrative agencies, *Agricultural wastes, Resources management, Soil erosion, Soil conservation, Pollution load, Policy making, State jurisdiction, Economic aspects.

Many administrative arrangements have been made to restore and maintain the nation's water quality pursuant to the Federal Water Pollution Control Act Amendments of 1972. However, the arrangements to implement agricultural nonpoint pollution control programs reflect the difficulties surrounding agricultural nonpoint pollution. The physical processes resulting in sediment, plant residue and chemical pollution are not fully understood. Thus, most states have shied away from major political or financial commitments to pollution control and have not exercised pollution control authority because enforcement would be difficult without hard evidence of culpability. Soil loss has become a major proxy indicator for pollution problems but this has shifted the burden to soil conservation districts to implement primary agricultural nonpoint pollution control programs. Cutbacks in federal funding and little additional state and local support make the district's capabilities to carry out these programs questionable. The soil conservation agencies have the infrastructure to implement control programs (whereas pollution control authorities don't) but their goals are not always in concert with pollution control. Nonpoint pollution varies in composition and severity among states, and few have done more than identify and plan abatement activities. Targeting control efforts are needed as are criteria for abatement control and for directing funds toward critical areas. The ideal strategy would be a multipurpose resource management agency which would allocate state and federal funds as well as require pollution control actions by landowners, with suitable compensation. (Atkins-Omniplan)
W83-03559

WATER RIGHTS TRANSFERS: A LEGAL, ECONOMIC, AND INFORMATIONAL ANALYSIS OF WATER IN OREGON,
Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economics.
R. G. Kraynick, G. W. Whittaker, B. P. Bhadra, H. H. Stoevener, and J. L. Huffman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235283, Price codes: A15 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-78, Oregon State University, Corvallis, May 1983. 339 p, 18 Fig, 19 Tab, 175 Ref, 4 Append. OWRT B-069-ORE(1), 14-34-0001-9130.

Descriptors: *Water law, *Water rights, *Water rights transfers, *Doctrine of Prior Appropriation, *Appropriative rights, Legal aspects, Economic aspects, *Econometrics, Agriculture, Conservation, Judicial decisions, *Oregon, Surveys, Water users, Mathematical models, *Oregon, North Powder River.

The doctrine of prior appropriation (DPA) poses theoretical and practical constraints on decentralized exchanges of water rights, owing to universal non-impairment provisions in statutes of states using DPA. Five issues concerning efficacy of DPA water right transfer system in Oregon were explored: administrative, legal, economic, joint legal-economic, and informational. (1) Administrative: record inspection (1970-1980) revealed that few transfers are accomplished in Oregon, with almost no exchanges between individuals. (2) Legal: enhanced transfer processes can affect efforts to conserve water by reducing legal uncertainty concerning the extension of conserved water to new lands or sales of conserved surpluses, an ambiguous matter in Oregon court findings. (3) Economic: an enhanced statistical procedure for evaluating the productivity of water used in agricultural processes was tested. (4) Joint legal-economic: examination of Oregon's DPA in modeling context provided a means of determining the norms the statutes are supposed to achieve and desirable market-enhancing revisions in the statutes. (5) Informational: responses from individuals in a survey indicate (1) few attempted sales or purchases, (2) few have knowledge of the legal transfer process, and (3) the sale of water conserved or extension of water conserved to new lands is a desirable option.
W83-03594

GROUNDWATER PROTECTION ON THE LOCAL LEVEL: INTEGRATING THE FRAGMENTS OF REGULATION,
For primary bibliographic entry see Field 5G.
W83-03628

CHANGING THE CLEAN WATER ACT: REFLECTIONS ON THE LONG-TERM.
Journal of the Water Pollution Control Federation, Vol 55, No 2, p 123-129, February, 1983.

Descriptors: *Water quality control, *Standards, *Wastewater treatment, Clean Water Act, Water pollution control, Effluent limitations, Water quality standards, Regulations, State jurisdiction, Federal jurisdiction, Industrial wastewater, Planning, Enforcement, Legal aspects, Financing, Permits, Legislation, Grants, Construction.

Since the present goals of the Clean Water Act cannot be met, proposals to fine-tune this basically sound legislation are presented. Dropping the 1985 date and extending the 1983 goal to 1993 would allow for 2 complete planning and evaluation cycles. The technology-based approach must be preserved. Overtreatment of wastewater should be minimized by considering the assimilative capacities of the receiving waters. It is recommended that appropriations for state program grants be maintained through 1993 to provide enough time for the states to develop alternative sources of funds. Much research and development should be shifted to the states, with a clearing house to avoid duplication of effort. Municipalities should be encouraged to provide wastewater treatment services as public utilities, thus developing funds for operation and eventual replacement of facilities. Current enforcement provisions of the Clean Water Act have been reasonably effective and should be retained. Options for strengthening the program include requiring discharges to publicize serious violations, imposing fines by administration rather than by court action, and bans on new connections to wastewater systems if necessary. Economic incentives for better water quality are payment to municipal treatment plants for good performance, use of circuit riding consultants, promotion of industrial waste exchanges to promote recycle and reuse, and encouragement of innovation by cash awards. (Cassar-FRC)
W83-03635

LEGAL AND INSTITUTIONAL CONSTRAINTS AND OPPORTUNITIES IN WETLANDS ENHANCEMENT,
S. McCreary.
In: Wetland Restoration and Enhancement in California, M. Josselyn, ed. California Sea Grant College Program Report No T-CSGCP-007, Tiburon Center for Environmental Studies, San Francisco State Univ., December 1982. p 39-52, 1 Fig.

Descriptors: *Wetlands, *Watershed management, *Institutional constraints, *Legal aspects, *Aquatic habitats, Estuaries, Habitats, Shore protection, Policy making, Coastal zone management, Ecosystems, Coastal marshes.

Wetlands restoration is guided by complex, overlapping laws, agency policies, and attitudes, while concurrently trying to reverse the trend towards loss of valuable habitats through catastrophic events (major dredging or filling projects) and gradual degradation (excessive siltation, loss of buffers, or interruption of freshwater flows). This paper gives an overview of the legal and institutional issues in California, including the evolution of state policy towards wetlands protection, federal trends in wetlands management, institutional issues surrounding land acquisition, watershed management and protection, the role of scientists in enhancement, and the role of citizen activists and non-profit organizations. California is also developing programs to manage unit resources--coupling the land side of the coastal zone together with the water side thus creating a unified zone of watershed, shoreline, and waterbody. Various management techniques are used, including land use regulation, land acquisition by public agencies, and on-site stewardship. Ten recommendations are offered to move from general goals towards comprehensive implementation plans: make restoration an explicit resource policy goal; simplify the permit process; develop mechanisms that enable negotiations for off-site mitigation; improve methods to involve scientists and scientific information; refine the ecosystem management strategy; streamline the land acquisition process; expand the role of non-profits as land acquisition agents; recognize watershed as the logical unit for ecosystem management; recruit the private sector for technical/financial support; and unify the fragmentary wetlands restoration community. (Atkins-Omniplan)
W83-03692

TECHNOLOGY TRANSFER PROGRAM: URBAN STORMWATER MANAGEMENT IMPLEMENTATION IN IOWA,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W83-03696

STATE OPTIONS FOR NONSTRUCTURAL FLOOD RISK MANAGEMENT,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 6F.
W83-03702

A COMPARATIVE EVALUATION OF GROUND-WATER MANAGEMENT TECHNIQUES,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 4B.
W83-03704

LEGAL ANALYSIS OF THE LEE COUNTY WATER SUPPLY PROBLEM,
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
M. C. Jarman, A. L. Sage, III,, and W. Hooper, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249615, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, April 1983. 60 p, 40 Ref, 1 Append. A-183-MS(1), 14-34-0001-2126.

Descriptors: *Water law, *Water allocation, *Water rights, Water management, Water rates, Financing, Groundwater management, *Mississippi, Lee County, Conjunctive use, Water conservation, Water demand, *State regulation.

The rapid economic expansion of Lee County, Mississippi, has created a demand for water that will require the county to supplement its present utilization of groundwater with surface water by the year 2000. An engineering study conducted by the Tennessee Valley Authority has recommended a long-range plan that combines effective water conservation measures with a cost-effective conjunctive use of surface groundwater. This paper identifies and discusses legal issues that arise from the proposed plan as well as currently existing legal authority that is available for managing water resources in the Lee County area. The legal issues discussed include: (1) state regulation of surface waters, with primary emphasis on Mississippi's Water Conservation Law; (2) state regulation of groundwater, including discussion of Mississippi's very limited Ground Waters Act, different theories of groundwater regulation, and an examination of case law from Mississippi and other jurisdictions; (3) a discussion of three federal statutes, the Safe Drinking Water Act, National Environmental Policy Act of 1969, and the Rivers and Harbors Appropriation Act of 1899, that affect the proposed plan; (4) an analysis of the relative abilities of the Tombigbee River Valley Water Management District and the Lee County Board of Supervisors to implement the proposed plan; and (5) a discussion of district project, financing and rate making. The report includes some suggestions for revisions of current Mississippi water resources law.
W83-03720

INSTITUTIONAL FRAMEWORK FOR CONJUNCTION USE OF SURFACE AND GROUNDWATER IN TUPELO-LEE COUNTY, MISSISSIPPI: PHASE II,
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
For primary bibliographic entry see Field 4B.
W83-03721

WATER RIGHTS, WATER REGULATION, AND THE 'TAKING ISSUE' IN HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
W. Kloos, N. Aipa, and W. B. C. Chang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-249706, Price codes: A08 in paper copy, A01 in microfiche. Technical Report No 150, May 1983, 114 p. OWRT B-062-HI(1), 14-34-0001-1113.

Descriptors: *Water rights, *Riparian rights, *Legal aspects, Water allocation, Public trust doctrine, Groundwater, Streams, Constituional law, *Hawaii, *Native Hawaiian water rights, *Appurtenant water rights, In-stream uses, Regulatory mandate, McBryde v. Robinson, Constitutional mandate.

The unique situation concerning water rights in Hawaii presents some particular difficult legal questions. This report analyzes the Constitution, 'taking' issues involved if Hawaii were to move from its present, judicially created system of water rights to a system allocating water based on limited-duration permits. Such a problem arises under the Fifth Amendment of the United States Constitution (prohibiting the taking of property without just compensation) because present Hawaiian water rights, namely riparian, appurtenant and konohiki water rights,could be considered 'property'. Replacing such righs with permits of limited duration, or the failure to grant a permit to an existing inchoate use, might therefore be considered a taking. Hence, the issue as to whether or not compensation in such cases is constitutionally compelled casts a pall of legal and economic uncertainty over the adoption of a permit system. A model is developed for answering these questions based on the following steps: (1) the determination of the present state of water rights, (2) ascertainment of the degree to which these rights constitute 'property' in a constitutional sense, (3) an assessment of the degree to which a comprehensive regulatory system is required by the constitutional amendement on water resources, (4) a discussion of the desirability of a limited-duration permit system, (5) the derivation of a test for determining whether a taking has occurred, and (6) the isolation of different factual patterns which would raise a taking question. The constitutional analysis proceeds under the assumption of a pre-McBryde state of affairs since this presents a 'worst case' scenario and magnifies the constitutional issues involved. In conclusion, a limited duration-permit system is recommended as a constitutionally permissible and viable means of maintaining the needed flexibility to meet future demands and shifting uses.
W83-03779

6F. Nonstructural Alternatives

STATED FINANCING POLICIES OF GOVERNMENT AGENCIES AND THE EXPERIENCE OF RURAL WATER SUPPLY SYSTEMS,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6A.
W83-03606

MAKING WAVES: PUBLIC PARTICIPATION IN STATE WATER PLANNING,
North Carolina Univ. at Chapel Hill. Dept. of City and Regional Planning.
D. R. Godschalk, and B. Stiftel.
Journal of Applied Behavioral Science, Vol 17, No 4, 1981. p 597-614, 2 Fig, 6 Tab, 16 Ref. OWRT A-096-NC(4), 14-34-0001-9035.

Descriptors: Water quality, *Public participation, Decision making, *Policy making, Management planning, Water pollution control, Public policy, Public opinion, Environmental policy, North Carolina.

In North Carolina the 208 plan is the response to Federal Law which requires states to control sources of water pollution, and to facilitate public participation in planning for water quality management. An evaluation was made of public participation in 208 planning. The middle-class, self-interest bias was found in the NC program as in most U. S. public participation. Despite earnest efforts to involve a broad spectrum of the public, leaders of affected interest groups-farm, business, and local government-dominated participation. Initially, state water planners sought public support for stronger regulation of pollution sources, but ended with a considerably milder plan in which mandatory regulation was shelved in favor of voluntary compliance by pollution produces. People without a direct economic interest largely failed to participate, thus if the state planners had concentrated on mobilizing environmental and civic activists, they probable would have generated more support for strong regulations. Because the final plan recommendations were more closely in agreement with participant opinion than were earlier drafts or staff positions, the public can be expected to give greater support to the 208 plan as a result of participation. This work presents an approach to public participation evaluation research that can be used to refine existing participation theory.
W83-03614

MANAGING THE RISK AND LIABILITY OF TOXIC CONTAMINATION OF WATER SUPPLY,
Geomet Technologies, Inc., Rockville, MD.
R. T. Allen, C. I. Judkins, Jr, and W. E. McQueeney.
Journal of the New England Water Works Association, Vol 96, No 4, p 286-297, December, 1982.

Descriptors: Water pollution sources, *Liability, *Legal aspects, Insurance, *Groundwater contamination, *Risks, *Water pollution control.

Well closings are occurring nationwide due to contamination of their waters with organic compounds, insecticides, chlorides, nitrates, metals, inorganics, landfill leachates and industrial wastes. The primary cause of groundwater contamination is inappropriate waste disposal practices. It is noted that 12 separate epidemiological studies have implicated waterborne carcinogens in excess cancer mortality. At present, 90% of the toxic chemicals in drinking water remain unidentified. The legal aspects of insurance for the water companies and their employees as well as the local township managment against injury from contaminated water are considered. A strategy is presented to manage the risk and liability of toxic contamination of water supplies. The first segment of the strategy calls for interviews, surveys, and mappings of the area proximate to the water source in order to obtain a rough estimate of the risk of toxic contamination, any threat to human health, and potential liability claims upon the utility. The second segment is a preliminary analysis of the raw water via appropriate GC/MS and atomic absorption analysis of samples. Third is a detailed analysis of problematical sites; and fourth is the design and implementation of programs to maintain quality, advise and assure customers and cope with liability aspects including appropriate insurance, periodic audits, water quality monitoring steps, interface with regulatory bodies, and communication with the public and customers. (Baker-FRC)
W83-03630

THE ESTIMATION AND APPLICATION OF THE DEMAND FOR DISCHARGE WITHIN THE CONTEXT OF WATER QUALITY MANAGEMENT SYSTEMS,
Clemson Univ., SC. Dept. of Economics.
M. T. Maloney.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246504, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Publication No 105, Clemson Univ., SC., June 1983. 65 p, 4 Tab, 65 Ref. OWRT B-128-SC(1), 14-34-0001-0246.

Descriptors: *History, *Standards, *Marketing, *Institutions, *Water quality standards, *Effluent charges, Economic aspects, Water quality, Impaired water quality, Planning, *Costs, Comparative costs, Incremental costs, Cost estimation.

This study is composed of three parts. The first is a history of water pollution control legislation following the 1972 Federal Water Pollution Control Act. Part two is a theoretical investigation of pollution control institutions. The third section is a review of an analytical technique helpful in estimating the value of transferability of pollution permits. The history of water pollution control regulation shows the divergence of actual regulatory practices from those advocated by policy analysts. Practice has tended toward the approaches where compliance was most easily monitorable. It is often omitted monitoring cost element

which is built on section two. There it is argued that to the extent any discretion is left to independent economic agents in adjusting pollution levels, transferable permits are superior to other approaches. Taxes force the problem of inducing unacceptably large levels of pollution should the tax be inappropriately set. Moreover, compliance monitoring is no less difficult. Standards have been the regulatory approach of choice because of monitoring. An estimate of the gains from shifting the regulatory regime away from standards towards transferable permit is useful in weighting the administrative costs of such a move. Section three develops a method for obtaining such an estimate based on the limited information generalized by the standards rule.
W83-03701

STATE OPTIONS FOR NONSTRUCTURAL FLOOD RISK MANAGEMENT,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
J. P. Royer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246512, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 196 North Carolina State Univ., Raleigh, June 1983. 133 p, 17 Fig, 3 Tab, 95 Ref, 3 Append. OWRT B-140-NC(1), 14-34-0001-1255.

Descriptors: *Flood plain management, *Nonstructural alternatives, *Public policy, *Planning, *Land use, Flood plains, Economic aspects, Cost-benefit analysis, Local governments, State jurisdiction, Legislation, Policy making, Flood Plain zoning, Coastal zone management, Insurance, *North Carolina.

Options for a program of nonstructural flood risk management in North Carolina are examined through analyses of (1) current state legislation governing flood plain management, (2) land-use patterns on North Carolina flood plains, (3) the attitudes of local officials toward alternative measures for nonstructural flood risk management, and (4) simplified methods for evaluating the costs and benefits of flood plain regulation and acquisition. The analyses reveal opportunities to modify existing policies toward flood plain management in the state; with efforts concentrating on (1) broadened local authorities for regulating flood plains and (2) expanded programs of technical and financial assistance by the state under a designated lead agency with a full-time interdisciplinary staff for flood plain management.
W83-03702

INDUSTRIAL WASTEWATER PRETREATMENT STANDARDS--A LOCAL APPROACH,
Burns and McDonnell, Kansas City, MO.
W. H. Lovell, S. A. Christopher, R. Ream, and R. Tippets.
Public Works, Vol 114, No 1, p 33-35, January, 1983. 2 Tab.

Descriptors: *Industrial wastewater, *Pretreatment of wastewater, *Effluent limitation, Wastewater treatment, St. Joseph, *Missouri, Standards, Regulations, Water quality control, Water pollution control, *Water quality standards.

St. Joseph, Missouri, has developed an industrial wastewater pretreatment program based on local industrial conditions and the capacity of the city treatment works. Forty-nine of the total of 175 diversified industrial plants contribute about 30% of the total wastewater. After establishing a list of maximum allowable pollutant concentrations for the municipal treatment plant influent, individual disagreements were worked out. Enforcement is flexible, allowing a variance for a limited period of time during which the pretreatment system is developed. Industries submit a compliance report semiannually. The city also monitors industrial discharges to verify the reports. If a suspension order is issued, the industry must stop contributing to the treatment plant until remedial action is taken. (Cassar-FRC)
W83-03765

IRRIGATION FUNDING NOW MORE RATIONAL,
J. Bornholdt.
New Zealand Journal of Agriculture, Vol 145, No 6, p 11, December, 1982.

Descriptors: *Irrigation, *Financing, *Loans, *New Zealand, Spray irrigation, Water policy, Economic aspects, Subsidies.

New Zealand's irrigation funding policies have been changed so that all schemes are on an equal basis. A 70% overall subsidy for off-farm developments applies to community and private schemes. A new rural bank loan is available to finance on-farm schemes. It allows for no repayment during the first three years of the loan. As a result of the policy change spray irrigation, an efficient user of water, is now eligible for loans on favorable terms. (Cassar-FRC)
W83-03811

INTERACTIVE NONSTRUCTURAL FLOOD-CONTROL PLANNING,
Camp, Dresser and McKee, Inc., Annandale, VA.
S. A. Hanson-Walton.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR3, p 333-334, October, 1982. 1 Ref.

Descriptors: *Flood damage, *Flood plain management, *Nonstructural alternatives, Planning, Flood control, Red Run River, Lower Clinton River, *Michigan.

A comment on 'Interactive Nonstructural Flood-Control Planning' by George F. McMahon, published in the Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, October, 1981, points out that the described planning tool is not economically feasible for the analysis of large numbers of structures (10,000). The Structures Inventory of Damages (SID) program and the Expected Annual Flood Damage (EAD) computation program were used together to study 75,000 structures on 357 reaches in the Red Run-Lower Clinton River watershed near Detroit, Michigan. SID calculates possible changes from representative samples. The EAD finds the damage-frequency relationship for each reach using the stage-damage relationship generated by the SID program. (Cassar-FRC)
W83-03831

6G. Ecologic Impact Of Water Development

SALINITY AND RESOURCE DEVELOPMENT PROBLEMS IN EAST KENT,
P. W. Herbertson.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 6, p 415-436, December, 1982. 8 Fig, 5 Tab, 6 Ref.

Descriptors: *Saline water, *Agriculture, *Water resources development, Irrigation water, Reservoirs, Marshes, Mine drainage, Estuaries, Water management, Stour Estuary, *United Kingdom, Water use.

The salinity regime of the Lower Stour Estuary system in East Kent was investigated to predict the effects of further water abstraction on water quality. A major source of saline water other than seawater is discharges from several collieries. The river basin contains many former marshes now used for culture of a wide variety of crops and for livestock raising. The Richborough Power Station is licensed to abstract 136.8 ML per day of cooling water. A public water supply reservoir was proposed and rejected because it was deemed too intrusive to the valley. Increasing summer demands led to the request for additional abstraction from the tidal river. Modeling of the estuary system indicated that under low flow conditions the irrigation water quality would be difficult to maintain, that the mine water discharge was a significant factor, that increasing agricultural demands would require improvement in water quality or in the existing gravity marsh feeding facilities, and that the proposed reservoir could increase the available water to the marshes by 40%. It was recommended that the mine discharges be diverted via a 6 km pipeline to join a pipeline emptying into the sea and that pumping stations be installed to feed the marshes. (Cassar-FRC)
W83-03645

HYDROLOGIC EVALUATION OF SMALL IMPOUNDMENTS IN ARID AND SEMIARID REGIONS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
D. D. Evans, D. W. Young, and L. P. Onyskow.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243063, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Tucson, Ariz., June 1983. 33 p, 6 Fig, 21 Ref. A-083-ARIZ(1), 14-34-0001-8003.

Descriptors: *Reservoir siting, *Hydrology models, Water loss, Seimiarid lands, Southwest U. S., *Arizona, Model studies, Sonoita Creek watershed, Impoundments, Reservoir releases, Simulation.

In the arid and semiarid regions of the Pacific Southwest there is interest in the further development of small impoundments of water for recreation or other purposes by private enterprise or government agencies. Such impoundments have downstream hydrologic impacts which need to be evaluated prior to construction. The objective of this research was to develop a scheme for evaluation which is simple and has minimum data requirements. A model was constructed whereby the potential hydrologic impacts of small reservoirs can be evaluated prior to their construction. The methodology is simplistic and requires easily obtainable data, so that numerous modifications to such variables as reservoir capacity, spillway releases and controlled releases can be made and analyzed in a short peiod of time. Several models were evaluated for simulating rainfall/runoff, lake water balance, and downstream surface hydrologic impacts for controlled and uncontrolled releases for a proposed reservoir. The models were tested with data from the Sonoita Creek watershed in Southern Arizona, which contains a 200 acre impoundment. No simple model was found to adequately describe rainfall/runoffs for an ungaged watershed.
W83-03667

POPULATION BIOLOGY IN SMALL HAWAIIAN STREAMS,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. A. Kinzie, III,, and J. I. Ford.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243154, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 147, October 1982. 83 p, 17 Fig, 13 Tab, 34 Ref. OWRT A-080-HI(1), 14-34-0001-1113.

Descriptors: *Fish populations, Freshwater fish, *Fish genetics, *Crustaceans, Biology, Ecology, Streams, *Lentipes concolor, *Threatened species, Maui, Kauai, Molokai, Oahu, *Hawaii.

Intensive stream surveys were conducted on Maui and Kauai in Hawaiian island streams during October 1979 through 1982 to investigate whether the presence of predaceous eleotrids in terminal reaches of low-gradient streams excluded the rare goby, Lentipes concolor, from this habitat and restricted it to higher elevations. An attempt was also made to determine whether a correlation exists between seasonality of stream discharge patterns and the two life history parameters (spawning and recruitment) of the indigenous, diadromous species. Two small perennial streams, Pua'alu'u and Pepeiaolepo, on the island of Maui, and another small stream, Maunapuluo, on the precipitous Na Pali Coast of Kauai were selected as study areas. Although evidence indicated that Eleotris

sandwicensis preys upon gobies and rarely coexists with Lentipes, many other factors influence the effectiveness of Eleotris as a predator. Factors affecting the distribution and abundance of Lentipes are complex. No sharply defined periodicity was found in the recruitment of diadromous fishes, crustaceans, or mollusks. In-stream factors, among-stream and among-island differences in physical and biotic parameters apparently make recruitment into small Hawaiian streams an event in which chance plays a dominant role. In larger streams these stochastic processes may be averaged out and populations of these indigenous animals are more stable. The importance of these physical, biotic factors in determining the disturbance of populations of native stream fauna is discussed.
W83-03676

DEVELOPMENT OF REGIONAL WETLAND RESTORATION GOALS: COASTAL WETLANDS,
California Coastal Commission, San Francisco.
J. Zentner.
In: Wetland Restoration and Enhancement in California, M. Josselyn, ed. California Sea Grant College Program Report No T-CSGCP-007, Tiburon Center for Environmental Studies, San Francisco State Univ., December 1982. p 24-31.

Descriptors: *Wetlands, *Coastal waters, *Watershed management, *Regional development, *Watershed development, Standards, Wildlife habitats, Habitats, Shore protection, Primary productivity, Tidal lands, Salt marshes, Tidal flats, Water birds, Wildlife.

Of 381,000 acres of coastal wetlands in California prior to 1900, only 105,000 acres remain today. The California Legislature resolved that in the next 20 years, 50% more wetlands should be created; however, to be successful, a restoration plan must determine what types and how much of particular habitats are most needed, or valuable for each restoration project. Coastal wetlands have a set of values and each value has a recognized utility. Eight values are cited as representing the values of wetlands: high primary productivity, shoreline protection, wildlife habitat, water purification, groundwater recharge, flood protection, habitat for commercially important fish and shellfish, and cultural values, such as education and recreation. The major value of California's coastal wetlands is as a plant and wildlife habitat. These wetlands have little value for most commericial fish or as horseline protectors, water purifiers, groundwater rechargers or flood controllers. Primary productivity of wetlands is high but wildlife utilization of that production occurs within the wetland. Cultural values depend on the wetland's value as a plant and wildlife habitat. Additionally, of 12 endangered or rare California species of birds, reptiles and mammals, nine are residents of or associated with coastal wetlands and five are almost entirely dependent on salt marshes. The creation of habitat for wildlife and human use should be the major restoration goal on a statewide basis, but each habitat's latitude must be considered. The values for the North, Central and South regions are different, therefore, the restoration goals must be resolved within their regional frameworks. (Atkins-Omniplan)
W83-03691

INSTREAM FLOW REQUIREMENTS FOR FISH AND FISHERIES IN MARYLAND,
Maryland Univ., Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 2E.
W83-03776

MACROINVERTEBRATE COLONIZATION OF MULTIPLATE SAMPLERS IN THE OHIO RIVER: THE EFFECT OF DAMS,
Cincinnati Univ., OH. Dept. of Biological Sciences.
D. C. Beckett, and M. C. Miller.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 12, p 1622-1627, December, 1982. 1 Fig, 3 Tab, 29 Ref.

Descriptors: *Dam effects, *Invertebrates, *Water currents, *Ohio River, Macroinvertebrates, Aquatic habitats, Flow velocity, Amphipods, Midges, Aquatic insects, Aquatic animals, *Environmental effects.

The effects of river current velocity on macroinvertebrate colonization of multiplate samplers were studied in fast and slow currents (downstream and upstream of a surface release dam) in the Ohio River in 1979. Slow water colonies were dominated by the amphipod, Gammarus sp.; fast water colonies, by hydropsychid caddisflies. The winter stonefly Taeniopteryx burksi and the chironomid Polypedilum illinoense were significantly more abundant in slow water; the chironomids Cricotopus bicinctus, P. convictum, and Rheotanytarsus sp., and the caddisfly Hydropsyche orris were more abundant in fast water. When colonized sampler plates were moved to the opposite type of current, the colonies gradually changed composition with time to form communities more typical of the current velocity. These changes seemed to be independent of crowding of living space, dissolved oxygen, temperature, and conductivity of the water. (Cassar-FRC)
W83-03824

7. RESOURCES DATA

7A. Network Design

RIVER BASIN WATER QUALITY MONITORING NETWORK DESIGN,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W83-03593

7B. Data Acquisition

DEVELOPMENT AND CONSTRUCTION OF A STATIONARY MEASURING SYSTEM FOR LIMNOLOGICAL OBSERVATIONS ON THE AMMERSEE (ENTWICKLUNG UND BAU EINES STATIONAREN MESSSYSTEMS FUR LIMNOLOGISCHE BEOBACHTUNGEN AUF DEM AMMERSEE),
G. Michler, and B. Wuschansky.
Wasserwirtschaft, Vol 72, No 5, p 215-217, May, 1982. 3 Fig. (No English Summary).

Descriptors: *Measuring instruments, *Limnology, *Hydrometeorology, *Data collections, *Data interpretation, Data transmission, Floats, Floating measuring station, Ammersee, *Federal Republic of Germany, Electronic equipment, Microelectronics, Energy transfer, Metabolism, Phytoplankton, Air temperature, Water temperature, Costs, Ammersee.

A floating measurement platform with independently designed and assembled electronic equipment (based on the principles of microprocessors) for measuring, transmitting, receiving, and analyzing hydrometeorological and limnological data was constructed for use in the Ammersee (Federal Republic of Germany). The platform was designed to measure factors such as energy turnover on the lake surface, evaporation over a free water area, energy input via wind stress, temperature and density stratification, metabolism, population dynamics in relation to production factors, and sedimentation rate. Some of the parameters were suitable for continuous registration. The platform could hold six to eight persons and could be used for periodic studies to assess productivity (e.g., volume and composition of phytoplankton). It consisted of two floats, each made of four 216-liter oil barrels welded together. The platform was filled with 20 kg polyurethane foam to make it almost unsinkable. The floats were topped with wooden boards and railings. The atmospheric data collector and warning lights were carried on a 4-m-high mast. Electronic and voltage equipment was housed in a galvanized steel covered wooden chest. Two anchors were fashioned, each from five concrete-filled and steel-armored automobile tires. The platform was anchored 750 m from the lake bank (water depth, 21 m). Due to adverse weather and lake conditions and to the large number of cable cores (96) required, analog data values were digitalized and transmitted serially to the analyzing device via one carrier. The majority of the measuring capacity was used to determine temperature. Equipment for lighting protection was installed. The cost of the platform was 3,000 DM, that of the electronic equipment was 6,000 DM. (Gish-FRC)
W83-03527

AUTOMATIC DETERMINATION OF SNOW COVER (SCHNEEDECKE AUTOMATISCH ERFASST),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
B. Schadler, and F. Koch.
Wasser, Energie, Luft, Vol 73, No 1/2, p 15-16, January/February, 1981. 2 Fig, 3 Ref. English Abstract.

Descriptors: *Snow cover, *Gamma radiation, *Rain gages, *Soil moisture, *Measuring instruments, Gamma snow control, *Switzerland, Reservoirs, Potential water supply, Alps, Flood flow, Flood control, River flow, Water level, Snow depth, Snowmelt, Thaw, Water supply, Forecasting, River forecasting, Flood forecasting.

The ability to determine the water equivalent of winter snow cover is important in Switzerland, since the summer volume of many alpine reservoirs and the flow of Swiss midland rivers are dependent on this. An automatic device to perform this function is described: the gamma snow sound, whose measurements are based on the attenuation of gamma radiation as it penetrates a medium. The equation used to calculate this attenuation involves the relationship between the intensity of the gamma radiation, a medium-specific absorption coefficient, and the depth of the irradiated snow. The device, which has been in use since 1975, employs a cobalt-60 radioactive source of 7.5 millicuries (half life 5.25 yr). The same type of device may also be used to determine soil moisture: three Geiger-Muller (GM) counters are sunk into the soil, and the additional weakening of radiation intensity with increasing soil moisture allows an estimation of water content changes in the entire soil layer between the surface and the buried GM counters. Results can be printed out or stored. An example is given of measurements made in the winter of 1979/80 in the Rietholzbach catchment area (Switzerland). Snow cover built up from mid-December to its greatest depth on 23 January, when it was 85 mm water equivalent, which corresponded to a water reserve of 270,000 cu m for the area. A thaw accompanied by heavy rain ensured in February, after which a flood wave of 3,440 cu/m sec was measured on the Rhine at Rheinfelden. (Gish-FRC)
W83-03529

A QUESTION OF SAMPLING,
Welsh Water Authority, Powys (Wales). Directorate of Scientific Services.
D. G. Salker.
Effluent and Water Treatment Journal, Vol 22, No 5, p 184-185, 187-189, 191, May, 1982. 3 Fig, 10 Ref.

Descriptors: *Sampling, *Measuring instruments, *Design criteria, Sample preservation, Sample preparation, Water sampling, Biological samples, Water analysis, Chemical analysis, Pollutant identification.

A brief introduction to the concepts, applications and limitations of sampling as a means of water quality monitoring is presented. The nature of sampling is briefly discussed in addition to the practical aspects that are of assistance in answering questions such as what type of sample should be taken, where should sampling be done, when should samples be taken, how many are needed, and why sample at all. Sampling is an activity that may be used to abstract water quality information with great economy of effort, provided care is taken in all aspects of the planning of a scheme.

Good planning for sampling to be effective requires the following criteria and expertise to be met: a clear idea of the objective of the program, sound technical knowledge, and good judgement aided by statistical techniques where needed. In most cases discrete, intermittent sampling is used as opposed to continuous sampling for economic and other practical considerations. In choosing a position from which to sample, care must be taken to provide samples that are valid. Samples should be taken so as to reveal any differences in diurnal times, variations between days, weeks, months or seasons. There are two major types of samples: the single discrete sample and the composite sample. The number of samples needed to indicate various findings is discussed. (Baker-FRC)
W83-03595

EVALUATION OF A DISSOLVED OXYGEN FIELD TEST PROTOCOL,
National Bureau of Standards, Washington, DC. National Engineering Lab.
G. Kulin, W. W. Schuk, and I. J. Kugelman.
Journal of the Water Pollution Control Federation, Vol 55, No 2, p 178-186, February, 1983. 9 Fig, 4 Tab, 5 Ref.

Descriptors: *Dissolved oxygen, *Wastewater analysis, *Measuring instruments, Oxygen, *Wastewater treatment, Activated sludge process, Aeration, Calibration, Standards.

A test protocol developed for on-line dissolved oxygen meters was evaluated in a 60-day field test in an extended aeration activated sludge tank. Thirteen meters from seven manufacturers were tested. A portable dissolved oxygen meter was used as a transfer standard. Calibration was done with clarifier effluent. Experience during the test resulted in several suggestions for operating these meters. The portable reference probe should be slowly oscillated during readings to avoid entrapment of air bubbles. On-line meters should not be recalibrated on the basis of readings during the first day or two. The probe and its support structure should have smooth contours and interior wiring to prevent fouling with the stringy materials present in the tanks. The sensor should be exposed directly to the aeration basin, but not directly perpendicular to the strongest currents. Mechanical devices used to hold the probe assembly should allow quick release. The design should facilitate quick membrane replacements. Membrane and probe cleaning on a regular basis is not recommended unless readings indicate fouling. (Cassar-FRC)
W83-03631

ELECTROMAGNETIC DETERMINATION OF SOIL WATER CONTENT USING TDR: I. APPLICATIONS TO WETTING FRONTS AND STEEP GRADIENTS,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
G. C. Topp, J. L. Davis, and A. P. Annan.
Soil Science Society of Americal Journal, Vol 46, No 4, p 672-678, July/August, 1982. 10 Fig, 18 Ref.

Descriptors: *Soil water, *Leaching, *Predicting, Soil moisture availability, Drainage, Dielectric constant, *Time-domain reflectometry.

The applications and limitations of time-domain reflectometry (TDR) are studied when used on parallel transmission lines for measurement in a field simulation. Experiments were conducted in a laboratory where simulations of wetting and drying were better controlled. The TDR method using parallel wire transmission lines is a practical and useful technique to measure soil water content averaged over depth even when steep gradients or wetting fronts are present. Where a uniform dielectric constant exists it is possible to measure both the distance to the wetting front and the amount of water behind the wetting front during an infiltration experiment if one uses the fact that the TDR trace shows the impedance difference between dry and wet soil. The water content measured by the TDR technique was found to be the same as the average water content to within 0.01 cubic cm/cubic cm in extremely nonuniform conditions. (Baker-FRC)
W83-03766

A PERMEAMETER WHICH ELIMINATES BOUNDARY FLOW ERRORS IN SATURATED HYDRAULIC CONDUCTIVITY MEASUREMENTS,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
R. L. Hill, and L. D. King.
Soil Science Society of America Journal, Vol 46, No 4, p 877-880, July/August, 1982. 4 Fig, 7 Ref.

Descriptors: *Permeability coefficient, *Measuring instruments, Permeameters, Acrylic swelling, Soil properties.

In many laboratory hydraulic conductivity measurements, flow of solution along the soil-permeameter wall interface is a major source of error. A permeameter is described which has been designed to eliminate boundary flow errors during such measurements. The permeameter is in three parts. The top and bottom sections are constructed from acrylic resin materials. The center section is an aluminum sleeve. In the experiments performed, the boundary flow consistently exceeded center flow by 54 to 23% during the first 154 h of leaching. Diminishing differences in hydraulic conductivity (K) between the two regions were attributed to slight swelling of the soil mass, movement of dislodged soil particles into the higher velocity region of the boundary flow, or both. Differences in the K for the boundary and center flow regions were not as great as in earlier studies; however, the soil used here was relatively nonexpansive. The permeameters appear to effectively eliminate boundary flow from the hydraulic conductivity measurement. Through the use of the removable aluminum sleeve, the permeameters offer advantages in adaptability to disturbed and undisturbed soil samples and in elimination of problems associated with acrylic swelling. (Baker-FRC)
W83-03770

A DEW-POINT HYGROMETER FOR FIELD USE,
Oregon State Univ., Corvallis. Dept. of Forest Engineering.
H. R. Holbo.
Agricultural Meteorology, Vol 24, No 2, p 117-130, June, 1981. 9 Fig, 1 Tab, 10 Ref.

Descriptors: *Hygrometers, *Dewpoint, *Humidity, Dewcels, Measuring instruments, Lithium chloride, Temperature, Evaporation.

A dewcel design has been used for measuring ambient dewpoint temperature at remote field sites. This hygrometer is based on the effectiveness of salts dissolved in aqueous solution to depress the equilibrium vapor pressure in the surrounding atmosphere. Lithium chloride is effective over a wide humidity range. The hygrometer's sensor is heated electronically rather than by conduction through salt solution, reducing size and power requirements of the unit. The sensor configuration differs from that of the Campbell version in that it has a 40% smaller surface area and uses fine-gage platinum electrodes, a tightly woven fiberglass fabric for holding the salt, and small-gage support wires. The bobbin heater is a vitreous-enameled wire-wound power resistor. Transistor heat-sink grease provides a thermal coupling between thermometer and bobbin. In field tests the dewcel design rarely departed from its calibration. Humidity-temperature discrepancies were rarely greater than 0.5C. It was necessary to keep the power turned on at all times while the lithium chloride solution was in the apparatus. On occasions when batteries went dead, dewcels were damaged by corrosion, and data was rendered useless. Damage was also caused by loose electrodes. (Cassar-FRC)
W83-03796

A SIGNAL RECORDING AND PRINTING SYSTEM FOR TELEMETERING RAINGAUGES,
Meteorological Office, Poona (India).
N. V. Iyer.
Mausam, Vol 33, No 3, p 355-360, July, 1982. 7 Fig, 2 Tab, 3 Ref.

Descriptors: *Rain gages, *Telemetry, *Data transmission, Remote sensing, Automation.

The automatic signal recording and printing system for telemetering rain gage data used by the India Meteorological Department is described. The receiver and tape recorder are automatically switched on and off before and after the scheduled transmission time. The keyed continuous wave data in the teleprinter code are converted to highs or lows corresponding to long or short notes and are stored in a shift register. Data can be stored on tape and printed out. (Cassar-FRC)
W83-03801

ELECTROMAGNETIC DETERMINATION OF SOIL WATER CONTENT USING TDR: II. EVALUATION OF INSTALLATION AND CONFIGURATION OF PARALLEL TRANSMISSION LINES,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
G. C. Topp, J. L. Davis, and A. P. Annan.
Soil Science Society of America Journal, Vol 46, No 4, p 678-684, July/August, 1982. 9 Fig, 2 Tab, 6 Ref.

Descriptors: *Soil water, *Measuring instruments, Drainage, Infiltration, Permeability, Soil moisture availability, Time domain reflectometry, Dielectric constant.

Conditions where time-domain reflectrometry determined water content is both affected and not affected by the transmission line design are considered. TDR applied to parallel transmission in soil was used to measure the soil water contents during infiltration, drainage, evaporation, and rising water table conditions in a 1.05 m column of silt loam soil. Three types of installation and several types of transmission lines were evaluated. Comparisons of volumetric water content from gravimetric samples and from TDR showed differences were always less than 0.03 cubic cm/cubic cm. Lines with known electrical discontinuities provided a convenient and accurate way of determining water content profiles. In the silt loam soil used the reflections from discontinuities deeper than 60 cm were too small for confident interpretation at high water contents. The soil itself or some material with a dielectric constant larger than that expected in the soil should be used to fill the discontinuities unless corrections are made to the measurement. Installation of TDR lines in the field is not critical providing the rods are of small diameter for a 5-cm center-to-center spacing and the soil is tightly contacting the rod. The TDR technique using transmission lines in the soil offers great potential for measuring soil water content rapidly or for monitoring soil water content over long periods of time. (Baker-FRC)
W83-03806

7C. Evaluation, Processing and Publication

VARIATIONS IN MONTHLY PRECIPITATION OVER NORTH CAROLINA,
North Carolina Univ. at Chapel Hill.
B. K. Eder, J. M. Davis, and P. J. Robinson.
Report No 185, State Climatologist for North Carolina, Raleigh, January 1983. 55 p, 16 Fig, 1 Tab.

Descriptors: *Rainfall distribution, *Variability, *Precipitation, Rainfall, *Maps, *Climatic data, *North Carolina, Storage and retrieval.

This publication contains maps showing the distribution of mean monthly precipitation and variance across North Carolina for the thirty year period, 1951-1980. The spatial and temporal variability of precipitation over the state is examined through a statistical analysis of monthly normal precipitation data. Tables and maps derived from these data provide monthly precipitation means and standard

deviations for 85 locations in North Carolina. This report also contains information on data resources available, such as the Hydrological Information Storage and Retrieval System(HISARS), on the causes and distribution of precipitation in North Carolina, and on the use of the precipitation information. This report will be useful for both the general public and technicians in arriving at precipitation-related climatic decisions.
W83-03598

THE SNOWY RANGE OBSERVATORY: CLIMATOLOGICAL AND STREAMFLOW DATA REPORT 1982,
Wyoming Univ., Laramie. Water Resources Research Inst.
G. L. Kerr, and T. A. Wesche.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243147, Price codes: A05 in paper copy, A01 in microfiche. Completion Report January 1983. 89 p, 2 Fig, 3 Tab. OWRT A-030-WYO(1), 14-34-0001-2154.

Descriptors: *Climatic data, *Stream gages, *Hydrologic data, *Weather data collections, Hydrologic systems, Anemometers, Precipitation, Humidity, Temperature, Wind, Wind gages, *Data collections, Upper North Platte River Basin, Snowy Range, *Wyoming, Medicine Bow National Forest, Nash Fork Creek Drainage.

Data for 1982 climatologic and 1982 water year streamflow from the Snowy Range Water Resources Observatory are presented in this report. The Snowy Range Observatory are presented in this report. The Snowy Range Observatory is located in the Nash Fork Creek drainage of the Medicine Bow National Forest in the upper North Platte River Basin. Included in the Observatory are 21 recording precipitation gages, six recording hygrothermographs, five anemometers and seven streamflow gaging stations.
W83-03675

AGRO-ECOLOGICAL REGIONS OF WESTERN RAJASTHAN,
Central Arid Zone Research Inst., Jodhpur (India). Div. of Basic Resources Studies.
For primary bibliographic entry see Field 2A.
W83-03850

8. ENGINEERING WORKS

8A. Structures

PERFORMANCE IMPROVEMENT WITH BROAD-CROWNED SPILLWAYS (LEISTUNGSSTEIGERUNG BREITKRONIGER UBERFALLE),
Technische Univ., Dresden (German D.R.). Bereich Hydrobiologie.
G. Bollrich, and M. Rohner.
Wasserwirtschaft-Wassertechnik, Vol 32, No 7, p 235-237, July, 1982. 5 Fig, 8 Ref. (No English Summary).

Descriptors: *Hydraulic design, *Fluid mechanics, *Weirs, *Reservoir capacity, *Hydraulic profiles, Hydraulics, Hydraulic engineering, Hydraulic models, Model studies, Hydraulic geometry, Hydraulic loading, Dams, Reservoirs, Flood control, *German Democratic Republic, Theoretical analysis, Dam design, Dam construction, Spillways.

In practice, the design the front leading edge of broad- or flat- crowned weirs or spillways causes an energy loss (resulting from constriction or separation of flow and abrasion) that is expressed as a reduction of the spill factor C when compared with theoretical values. The use of a sharp-edged weir (the standard profile) in which the overflow profile conforms to the form of the lower flow surface, affords better hydraulic qualities and results in a higher C value. According to a theory that regards the standard profile as an uplift pressure profile, an increase in outflow of 61% is to be expected with a standard profile as compared to a broad-crowned weir when actual spill height (h)/ design spill height (hD) = 3. Boundary breakaway and flow separation can be avoided for weirs with standard profile with inbuilt uplift pressure as long as $h > 3.0 \times hD$. With this type of profile, the spill factor increases with increasing outflow, making it possible for the usable storage space of a reservoir to be enlarged. A lower spill height is required for flood relief, so that the weir crown can be raised. However, construction materials must be strong enough to withstand the uplift pressure with its associated possible pulsations and local cavitations. Theoretical studies and a hydraulic model experiment were conducted to investigate the possibility of transforming a broad-crowned weir in the German Democratic Republic into a weir with standard profile to make better use of its reservoir capacity. Results showed that the best solution was to construct a ramp with an uplift pressure profile at the front edge of the weir that was 0.60 m above the inflow edge. The broad-crowned inflow edge, with its advantages of low stress on the foundation, separation of hydraulic and excavation work, simple form, and low excavation requirements, was retained. Reservoir capacity could thereby be increased by 1.5 million cu m. (Gish-FRC)
W83-03518

THE WEINZODL POWER PLANT ON THE MUR (DAS MURKRAFTWERK WEINZODL),
Suiselectra Ingenieurunternehmung A.G., Basel.
W. Schaufelberger.
Wasserwirtschaft, Vol 72, No 5, p 195-200, May, 1982. 6 Fig. English summary.

Descriptors: *Hydroelectric plants, *Hydraulic engineering, *Dam construction, *Groundwater management, *Weirs, Mur river, *Austria, Groundwater movement, Computer models, Model studies, Construction, Engineering geology, Geology, Bedrock, Porous media, Percolation, Turbines.

The Weinzodl power plant on the Mur river near Graz (Austria) is a low-head, run-of-river facility composed of weir and machine house and having an installed capacity of 16 MW. The machine house on the left bank is fitted with two Straflo turbines (horizontal-axial, double-regulated turbines with outer-rim generators) and adjoins the three-field weir. Each turbine is designed for 90 cu m/sec water volume with a 9.8-m drop. The weir and machine house were constructed in a common excavation that is bounded by an upstream cofferdam (an earth dam sealed by a concrete louvered slide), a right-sided excavation seal with concrete louvered slide, a downstream cofferdam with louvered sealing slide, and a left-sided excavation seal with concrete louvered slide in the existing terrain. The entire 420-m perimeter is sealed in the porous bedrock (dolomite and sandstone) by a 15-m-deep injection curtain. This design was chosen to avoid influencing the groundwater insofar as possible, since Graz is situated in a groundwater protection area. Numerous computer simulation models of groundwater movement in the power plant's catchment area and calculations of flow through and under the excavation seal were undertaken to determine the degree of sealing required. An injection curtain was constructed to lengthen the percolation pathway from the upstream to the downstream side of the weir to ensure adequate resistance against shear stress (caused by increased water pressure resulting from the impoundment). The weir consists of a steel concrete sill and piers with three segment sluice gates with extension flaps. A small power plant utilizes the drop to the mill canal that branches off at a 45-degree angle near the right weir pier. Construction work was limited to a small area, since the plant was built at the site of a previous weir. Where the river banks were altered, they were planted with new trees and shrubs. (Gish-FRC)
W83-03526

LAKE WEIR DESIGNED TO RESIST ICE DAMAGE,
Oakland County Drain Commissioner's Office, Pontiac, MI.
G. Yrjanainen.
Public Works, Vol 113, No 8, p 62-63, August, 1982. 3 Fig.

Descriptors: *Weirs, *Ice, *Control systems, Water level, Orchard Lake, *Michigan Manholes, Damage, Lake ice.

A lake level control device in Orchard Lake, Michigan, was relocated 20 ft onshore to escape damage by windblown ice floes each spring. The land-locked lake overflows through a 24 inch pipe into Cass Lake across the road. The new adjustable weir control structure was housed in a 9 ft diameter masonry manhole and connected to Orchard Lake by an 18 x 29 inch corrugated metal pipe arch. The inflow pipe coupling was made of flexible material to allow movement with the ice. The structure has survived 2 severe winters without damage. (Cassar-FRC)
W83-03681

MANAGEMENT MODEL FOR POWER PRODUCTION FROM A GEOTHERMAL FIELD: 1. HOT WATER RESERVOIR AND POWER PLANT MODEL,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
T. Maddock, J. W. Mercer, and C. R. Faust.
Water Resources Research, Vol 18, No 34, p 499-512, June, 1982. 10 Fig, 6 Tab, 23 Ref.

Descriptors: *Powerplants, *Management, Model studies, Geothermal power, Geothermal resources, Water resources development.

Mathematical models are developed to determine the amount and rate of conversion to electric power for one particular source of geothermal energy, a liquid-dominated, hydrothermal reservoir. Two models are presented. The first is a model for a reservoir and relates the change in pressure to the extraction or injection of hot water at well sites. The second model is for a power plant and determines the intensive electrical power output, the intensive cooling requirements, and the stream quality mass fractions for the various components of a steam-flash, two stage, turbine condenser power plant connected to the well sites considered in the reservoir model. Capital costs, variable costs and annual fixed costs are obtained for the reservoir development, extraction and reinjection, the transmission system and the power plant. Revenues are dtermined for electrical power production. Application of the management model to a simplified yet realistic example reservoir demonstrated that the methodology developed herein can be used for analyzing the management of an integrated geothermal reservoir power plant system. For the example reservoir, 12 potential sites are developed, five for extraction wells and seven for injection wells. The wells on these sites are used to develop up to 27 MW of electrical power over a 20 year time interval. (Baker-FRC)
W83-03761

8B. Hydraulics

HYDRAULICS OF SOLVING UNSTEADY DEBRIS FLOWS,
Utah Water Research Lab., Logan.
R. W. Jeppson, and S. A. Rodriguez.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235507, Price codes: A05 in paper copy, A01 in microfiche. Utah Water Research Laboratory Hydraulics and Hydrology Series UWRL/H-83/03, June 1983. 88 p, 14 Fig, 16 Tab, 12 Ref, 3 Append. OWRT A-053-UT(2), 14-34-0001-1147.

Descriptors: *Debris flow, *Open channel flow, Mud flow, Flow density, *Flow viscosity, Energy loss, Fluid mechanics, Computer programs, Hydraulics.

Debris flows consist of movements of water so heavily laden with soil that the density is roughly twice that of water. Due to the many large solid particles, the viscosity of the mixture is many times that of water and large enough to cause the flow to exhibit typical laminar flow characteristics in which adjacent layers slide with respect to each other rather than intermix as occurs in turbulent flow. Hydraulic analysis of the flow requires an

equation for estimating headloss from density and viscosity and a framework for computing depths and velocities for the unsteady flow situations that occur in actual debris flows. A modified Chezy equation and DeLeon's relationship for relating energy loss to density and viscosity were previously combined into an equation for estimating friction slope in a steady-state debris flow. This report presents a computer program for calculating velocities and profiles for unsteady open channel debris flow. The method assumes that the debris flow has a leading surge followed by steady-state but gradually varied flow and extending back to the beginning of the channel. For the computations, data are provided on channel geometry, and slope. Applications are made to compare the solutions with measurements of known debris flows.
W83-03608

USING WATER DISTRIBUTION SYSTEM MODELS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski.
Journal of the American Water Works Association, Vol 75, No 2, p 58-63, February, 1983. 3 Fig, 31 Ref.

Descriptors: *Pipes, *Model studies, *Water pressure, Water distribution, Computer models, Water demand, Water use, Maps, Network design.

Practical guides for using water distribution system models are given. The user must first decide between a simulation or optimization approach. Simulation models give heads and consumption at all nodes and flows through all pipes and elements. Optimization programs yield pipe sizes, pump heads, or pipe locations to achieve an objective such as minimizing costs while meeting pressure constraints and water demands. Steady-state models solve the network at only one point in time and are useful for design. Unsteady-state models simulate system behavior at successive steps over time, indicating varying water use, pump and valve operation, and heads at reservoirs. Suggestions are given for choosing a program. Maps should fit on a single sheet, even if wall-sized. Skeletal systems, which eliminate many small-diameter pipes, produce acceptable results with less work. C factors (pipe friction factor) are usually set according to literature values and adjusted during model calibration. Two approaches to assigning water use to nodes start with assigning large commercial and industrial users to nodes. Then (1) household water users are aggregated or (2) uses are assigned to nodes on the basis or gpm/node, (gpm/acre) x (acre/node), or (gpm/mi) x (mi pipe/node). Calibration data can often be obtained from fire flow data. (Cassar-FRC)
W83-03641

DISCUSSION: FLOW RESISTANCE IN COARSE GRAVEL BED RIVERS,
Canada Centre for Inland Waters, Burlington (Ontario).
P. Engle, and A. R. Thomas.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 803-808, June, 1982. 3 Fig, 1 Ref.

Descriptors: *Sediment transport, *Gravel, *Flow resistance, River beds, *New Zealand, Bed load, Roughness coefficient, Statistical analysis.

Two discussions on the paper, 'Flow Resistance in Coarse Gravel Bed Rivers,' by G. A. Griffiths, published in the Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers in July, 1981, are given. The paper presented a comprehensive data set of hydraulic variables for New Zealand gravel bed rivers. Data were divided into rigid bed and mobile bed categories. P. Engle criticizes several equations in the original paper and explains the reasons for the perceived errors. A. R. Thomas comments on the statistical aspects of the paper and some of the conclusions reached. (Cassar-FRC)
W83-03644

DISCUSSION: BOUNDARY SHEAR IN SMOOTH AND ROUGH CHANNELS,
National Technical Univ., Athens (Greece). Applied Hydraulics Lab.
G. C. Noutsopoulos, and P. A. Hadjipanos.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 809-812, June, 1982. 2 Fig, 5 Ref.

Descriptors: *Hydraulic friction, *Boundary conditions, *Channel flow, Shear stress, Open channel flow, Flow characteristics.

The paper, 'Boundary Shear in Smooth and Rough Channels,' by D. W. Knight, published in the Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers in July, 1981, conceived an empirical relationship for the separation of mean wall and bed shear stresses in small rectangular open channels. The writers of this discussion have done similar work on simple and compound rectangular cross sections using the Preston tube and the velocity profiles method for measuring boundary shear stress. In general, results from the above paper and writers' work agreed closely. They also agree that the average wall and bed shear values become equal at an aspect ratio of 2.34 (2.4 in Knight's work). (Cassar-FRC)
W83-03652

DISCUSSION: MINIMUM SPECIFIC ENERGY IN COMPOUND OPEN CHANNEL,
Queensland Inst. of Tech., Brisbane (Australia).
R. G. Black, and D. D. Franz.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 798-802, June, 1982. 2 Tab, 1 Ref.

Descriptors: *Channel flow, *Nonuniform flow, *Velocity distribution, *Open channel flow, *Energy, Compound channels, Critical depth, Hydraulic properties, Fluid mechanics, Flow velocity.

M. W. Blalock's and T. W. Sturm's paper, 'Minimum Specific Energy in Compound Open Channel,' published in the Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, in June, 1981, is criticized because the parameter, Fc, developed to predict the critical condition in these channels is not satisfactory. It has not been proven that Fc can yield three critical depths, that it is appropriate for use with the gradually varied flow equations, or that the greatest depth at which Fc = 1 is the proper limit of subcritical flow. R. G. Black feels that the authors are mistaken in assuming that all minimum energy points in a compound channel represent critical conditions. D. D. Franz's discussion on the above paper points out that a uniform velocity distribution in compound channels cannot be assumed. The extension of critical depth concepts to channels with nonuniform velocity distributions is uncertain, and more experimental studies are needed. (Cassar-FRC)
W83-03653

SIMPLIFIED MATHEMATICAL MODEL OF UNSTEADY FLOW IN COMPLEX CHANNEL SYSTEMS,
A. A. Zibert.
Water Resources (English Translation), Vol 9, No 2, p 177-184, March-April, 1982. 3 Fig, 1 Tab, 14 Ref. Translated from Vodnye Resursy, No 2, p 89-98, March-April, 1982.

Descriptors: *Unsteady flow, *Model studies, Mathematical equations, Flow, Flood control, Open channel flow, *USSR, Lielupe River.

Calculation of unsteady flow in open channels are needed for solving various practical problems of hydraulic engineering and water management construction. For complex floodplains and river deltas a model of unsteady flow is used in which the floodplain is represented in the form of individual compartments or chambers interconnected by canals and spillways and separated by a system of dams and dikes. Bank storage, that is, water exchange between the surface flow and soils composing the floodplain, has a substantial effect on unsteady flow along the channel. The practical use of a proposed model is shown for the example of calculating wind setup-setdown phenomena and floods in the lower and middle course of the Lielupe River. The key problem of the investigated model is the division of the channel net into calculation compartments. The conditions affecting the selection of the boundaries between the compartments can be divided into the following three groups: first, the topographic characteristics of the channel and floodplain; second, the formal requirements following from the main assumptions of the model examined later, and third, the degree of detail of the available hydrometric, topographic, and hydrogeological information. The experience of using the investigated mathematical model of unsteady flow on a number of real objects indicates that it can be used for complex flatland channel systems. (Baker-FRC)
W83-03759

SEPARATION OF HYDRAULIC FLOW OVER TOPOGRAPHY,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
H. E. Huppert, and R. E. Britter.
Journal off the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY12, p 1532-1539, December, 1982. 5 Fig, 11 Ref.

Descriptors: *Flow separation, *Topography, *Sheet flow, Subcritical flow, Flow pattern, Flow obstruction, Flow around objects.

The hydraulic flow of a single layer of fluid will separate on the lee surface of a smooth topographic feature whenever the flow is subcritical everywhere, unless the height of the feature is very small. Results from open channel flume tests confirmed the validity of the theoretical equation. Conditions for flow separation in a two-layer flow were also determined. (Cassar-FRC)
W83-03830

8C. Hydraulic Machinery

DEVELOPMENT OF SUITABLE CLOSURE SPECIFICATIONS FOR REMOTE CONTROLLED BALL VALVES TO LIMIT WATER HAMMER IN PIPELINES OF THE ZWECKVERBAND LANDESWASSERVERSORGUNG STUTTGART (ENTWICKLUNG GEEIGNETER SCHLIESSGESETZE ZUR DRUCKSTOSSBEGRANZUNG BEI FERNGESTEUERTEN KUGELSCHIEBERN IN DEN FERNWASSERLEITUNG DES ZWECKVERBANDES LANDESWASSERVERSORGUNG STUTTGART),
Zweckverband Landeswasserversorgung, Stuttgart (Germany, F.R.).
D. Flinspach, J. Giesecke, and H. B. Horlacher.
Wasserwirtschaft, Vol 72, No 5, p 201-206, May, 1982. 11 Fig, 6 Ref. English summary.

Descriptors: *Conveyance structures, *Automation, *Water pressure, *Hydraulic valves, *Fluid mechanics, Water distribution, Hydraulics, Hydraulic properties, Ball valves, Drum valves, *Federal Republic of Germany, Stuttgart, Pressure distribution, Water mains, Pipelines, Reservoirs, Distribution reservoirs, Water conveyance.

The development of closure specifications for ball valves installed in the Stuttgart (Federal Republic of Germany) area water conveyance system is described. Installation of the valves was rendered necessary by the conversion of the network to an automatically controlled system because the existing pressure regulators, float-controlled drum valves, had to be closed manually if the regulating reservoir was full and inflow had to be completely shut off. The ball valves supplement the drum valves, which remain operational as long as they are self-controlled. Water hammer measurements and hydraulic studies were conducted to clarify the hydrodynamic criteria of the closing processes at the valves and the resulting pressure increases. Two measuring stations were set up: one with one measuring point and the other, at the regulating reservoir Oberberken on a steel gravity-feed water

main, with three (directly in front of the ball valve, at the Venturi tube, and in the short oscillating pipeline that leads from the main to the standpipe serially connected to the reservoir). The measured water hammer curve showed that water hammer built up to its highest value after about 3.5 min of continuous valve closing (at about a 25% closure angle) and gradually dissipated as it passed the measuring points. Throttling characteristics for ball and drum valves wereconsidered separately. The Oberberken results were used to develop optimal closure specifications. A three-step procedure is recommended. The first step lasts 2 min, wherein the valve proceeds from being completely open to 70% closed; in the second step (6 min) it progresses to 85% closed, and in the final 2-min step it proceeds to full closure. (Gish-FRC)
W83-03524

MAINTENANCE DREDGING IN THE PORT OF BRISTOL,
G. Foy.
World Dredging and Marine Construction, Vol 18, No 12, p 16-21, December, 1982. 9 Fig, 2 Tab.

Descriptors: *Dredging, *Siltation, *Hydraulic equipment, Basins, Ports, Bristol Port, Severn Estuary, Estuaries, Maintenance, *England.

The Port of Bristol Authority maintains and operates three impounded dock systems adjacent to the point where the River Avon joins the Severn Estuary, namely Portishead Dock, Avonmouth Docks and the Royal Portbury Dock. The Severn estuary has a very high tidal range, varying between 40 and 50 feet in spring tides; a very large amount of fine silt is held in suspension. Tidal channels are generally self-scouring, except for certain small local areas which show a siltation pattern attuned to the effects of local rainfall and some estuarial shoaling which has a cyclic pattern of movement. The siltation which requires dredging is located at the entrances to the various docks. To reduce the amount of such siltation pumping takes place after the high silt content times on the making of spring tides. At the city docks the bulk of the siltation arrives through the entrance and deposits mainly in the Cumberland Basin. Machinery used to perform the dredging process is described. (Baker-FRC)
W83-03539

THE MECHANICAL AND ELECTRICAL ASPECTS OF THE REMODELING OF KEMPTON PARK WORKS,
M. R. Dowding, and D. M. Clark.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 5, p 354-368, September, 1982. 5 Fig, 3 Tab, 3 Ref.

Descriptors: *Water treatment facilities, *Design criteria, Pumps, Motors, Butterfly valves, Valves, Mechanical equipment, Financial aspects.

The history and a description of the Kempton Park Works are outlined, together with the factors that led to the remodelling of the water works. Before remodelling the works had two storage reservoirs, primary filters, secondary filters, chemical treatment plant, and two engine and boiler house complexes. In the new plant the pumps are of the vertical spindle, single stage, split casing centrifugal type. Pipe diameters range from 450 to 1200 mm nominal diameter. Within the suction and delivery manifold and associated mains there are a total of twenty-five butterfly or sluice valves ranging from 450 to 1200 mm nominal bore, all provided within the pump and motor contract. On the basis of experience gained since the shutdown of the steam based plant the estimated cost of operating the remodeled works (in pence) has decreased to 4.9 p/water kWh from the extrapolated value for 1980/81 of about 12p. The figures reflect the reduction in number of employees from 54 to 24. It is also estimated that the overall efficiency of the works pumping operation has been increased from about 11.6% to 23.5%. (Baker-FRC)
W83-03586

NATURAL GAS PROVES TO BE ECONOMICAL FOR PUMPING WATER,
Needham Public Works Dept., MA.
B. E. Nagler.
Public Works, Vol 113, No 8, p 68-69, August, 1982. 1 Tab.

Descriptors: *Pumps, *Natural gas, *Costs, Energy sources, Needham, *Massachusetts, Operating costs.

Natural gas was the most economical energy source for the new well pumping station at Needham, Massachusetts, in 1974. A Ford 534 V-8 truck engine was installed to pump the well at a rate of 1 mgd. Use of the gas engine saved $19,100, compared with electricity, for the years 1977-81. However, repairs have been a problem because some parts are difficult to obtain and troubles are difficult to diagnose. Although the engine itself has been long-lived, many appurtenances have worn out. Efficiency could be further improved by pumping nearer to 100% of the time rather than the 50-80% as experienced thus far. (Cassar-FRC)
W83-03715

GEOMETRIC CHANGES BRING LOBE PUMPS INTO SEWAGE SLUDGE MARKETS.
World Water, Vol 5, No 12, p 31, December, 1982.

Descriptors: *Pumps, *Sludge, *Lobe pumps, Rotors.

Lobe pumps, which have no pistons or valves, have been adapted to pump low viscosity fluids such as water and sewage sludge. The modification prevents slippage of fluid through the gap between rotor and casing by departing from the circular shape. This change generally improves performance by 15%. Rubber-lined rotors are available wherever a suction lift is needed or if the fluid contains abrasive particles. (Cassar-FRC)
W83-03742

8D. Soil Mechanics

DYNAMIC ANALYSIS OF EARTH DAMS IN THREE DIMENSIONS,
Harding-Lawson Associates, Novato, CA.
L. H. Mejia, H. B. Seed, and J. Lysmer.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT12, p 1586-1604, December 1982. 13 Fig, 1 Tab, 23 Ref.

Descriptors: *Earthquakes, *Seismic waves, *Dam stability, Oroville Dam, *California, *Earth dams, Rockfill dams, Canyons, Model studies, Soil mechanics, Strain measurement.

Finite element techniques were used to describe the three-dimensional dynamic response of earth and rockfill dams to seismic disturbance. This method is useful in studying dams built in narrow canyons, which are only approximately described by plane strain conditions. The dynamic response of the Oroville Dam, California, during the August 1, 1975, earthquake and the dynamic material properties of the dam were evaluated using the proposed method. Back-calculation of the dynamic properties of the dam materials indicates that a K2max value of 170 is representative of the situ dynamic characteristics of the dam's gravels and cobbles. There was reasonable agreement between this value and the laboratory-measured values on scaled samples of the dam shell material and between the computed and recorded response of the dam. (Cassar-FRC)
W83-03651

FACTORS AFFECTING STRESS CELL MEASUREMENTS IN SOIL,
Haley and Aldrich, Inc., Cambridge, MA.
W. A. Weller, Jr., and F. H. Kulhawy.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT12, p 1529-1548, December, 1982. 9 Fig, 2 Tab, 38 Ref.

Descriptors: *Soils tests, *Stress cells, *Measuring instruments, Soil mechanics, Soil structure, Construction, Soil engineering, Soil properties.

Factors affecting stress cell measurements in soil are reviewed. Stress cells can be of two types: flexible diaphragm cells and stiff cylinder (or rigid piston) cells. Some common systems used to measure stress cell reponse are: resistance strain gage, vibrating wire strain gage, semiconductor strain gage, closed fluid system with pressure transducer, pneumatic systems, and solid semiconductor elements. Factors affecting stress cell measurements are listed in a table with the description of error and correction methods. Factors are: aspect ratio (cell thickness to diameter ratio); soil-cell stiffness ratio; diaphragm deflection (arching); cylinder of piston cell deflection; stress concentrations at cell corners; eccentric, nonuniform and point loads; lateral stress rotation; cross sensitivity; stress-strain behavior of soil; placement effects; proximity of structures and other stress cells; dynamic stress measurements; corrosion and moisture; placement stresses; and temperature. (Cassar-FRC)
W83-03657

8G. Materials

DISCUSSION: LONG-TERM PERFORMANCE OF EMBANKMENT DAM INSTRUMENTATION,
Water Resources Commission of New South Wales, Sydney (Australia).
A. C. Houlsby, and J. Dunnicliff.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT8, p 1091-1095, August, 1982. 2 Ref.

Descriptors: *Piezometers, *Pressure-measuring instruments, Embankments, Dams, *Measuring instruments, Bactericides, Performance evaluation, Maintenance.

The above-titled paper by John Dunnicliff, presented at the American Society of Civil Engineers International Convention, New York, New York, May 11-12, 1981, was the subject of two discussions. Houlsby endorsed the original author's preference for twin tube hydraulic piezometers and suggested practices for enhancing their service life and for renovating deteriorated systems. These practices included the use of quaternary ammonium bactericides in the water filling the tubes, vacuum flushing of the tubes, Boudon pressure gages arranged to avoid valve manipulation during readings, and a simple layout of lines and equipment. Kleiner and Logani suggested more reliable systems for monitoring performance of dams and foundations such as pneumatic piezometers and vibrating wire piezometers. The author replied to the discussions by reemphasizing the longevity of twin tube hydraulic piezometers. (Cassar-FRC)
W83-03642

DISCUSSION: PIEZOMETERS IN EARTH DAM IMPERVIOUS SECTIONS,
Slope Indicator Co., Seattle, WA.
P. E. Mikkelsen, and J. L. Sherard.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT8, p 1095-1099, August, 1982.

Descriptors: *Piezometers, *Pressure-measuring instruments, Pore water, Earth dams, Dams, Embankments, *Measuring instruments.

Comments on the above-titled paper, presented by James L. Sherard at the American Society of Chemical Engineers International Conference, New York, New York, May 11-12, 1981, disagree with the heavy emphasis on measuring subatmospheric pore water pressure and the strong endorsement of vibrating wire piezometers. A pneumatic, venting type piezometer is suggested for this purpose. The advantages and disadvantages of the pneumatic and vibrating wire diaphragm piezometers are discussed. Pneumatic tubing is limited to about 1000 m; vibrating wire leads function to at least 4000 m. Electrical storms or high voltage cannot damage pneumatic tubes but will disable vibrating wire systems. Pneumatic tube piezometers are easier to calibrate and 4-10 times less in

cost than vibrating wire piezometers. However, the vibrating wire system is more adaptable to automatic data handling. In reply Mr. Sherard reiterated some of the technical advantages of vibrating wire piezometers and also pointed out that wires are less likely to be damaged during construction or later by dam deformation. (Cassar-FRC)
W83-03643

THE INTERIOR SURFACE OF GALVANIZED STEEL PIPE: A POTENTIAL FACTOR IN CORROSION RESISTANCE,
Montgomery (James M.), Inc., Pasadena, CA.
K. P. Fox, C. H. Tate, and E. Bowers.
Journal of the American Water Works Association, Vol 75, No 2, p 84-86, February, 1983. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Corrosion, *Pipes, Steel, Zinc, Copper, Plumbing, Thickness specification, Australia, Korea.

Samples of ASTM A-10 galvanized steel pipe manufactured in the U.S., Australia, and Korea were examined as part of a study on pitting corrosion. Visual examination showed that the inner surface of the Australian pipe was relatively smooth and uniform, the Korean pipe was generally smooth with isolated blemishes and a ridge along the weld, and the U.S. pipe was most variable in surface characteristics, with color and texture variations along its entire length. The zinc coating met thickness specifications and was uniformly smooth on the Australian pipe, met thickness specifications but was substantially heterogeneous on the U.S. pipe, and was below specifications with intermittent surface anomalies on the Korean pipe. A pilot test with water containing copper doses of 0.05 to 5.0 mg per liter is underway to determine the effects of coating irregularities on corrosion. (Cassar-FRC)
W83-03650

A STUDY OF THE OCCURRENCE OF HYDROGEN SULFIDE IN SEWERS IN THE PIEDMONT AREA OF SOUTH CAROLINA,
Clemson Univ., SC. Dept. of Civil Engineering.
P. B. Zielinski, and L. E. Fay.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243105, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Publication No 106, June 1983. 49 p, 13 Fig, 5 Tab, 10 Ref, 1 Append. OWRT A-046-SC(1), 14-34-001-9043, 8043, 0143.

Descriptors: *Hydrogen sulfide, *Corrosion, *Sewer systems, Wastewater facilities, *Interceptor sewers, Sewer gas, Sewage bacteria, Lateral sewers, *South Carolina Piedmont.

This project involved a two year investigation of the occurrence of hydrogen sulfide in interceptor sewer lines in the Piedmont of South Carolina. The study was conducted in two parts, including the earlier survey of Piedmont communities according to known situations of hydrogen sulfide occurrence, and the followup field work which involved the determination of suitable sites for further study of hydrogen sulfide occurrence. The purpose of the study was to determine whether sufficient sulfide generation existed to cause corrosion problems and to determine the applicability of the sulfide generation model of R. D. Pomeroy to the South Carolina Piedmont. In most cases less than 0.5 ppm of sulfide was found which is considered insufficient to cause a corrosion problem. Comparison of data to the earlier Pomeroy Z-parameter and the EPA flow-slope relationship also verified that no serious corrosion situations existed in the lines that were studied. Attempts were made to follow discrete slugs of sewer flow in an attempt to verify the Pomeroy generating model, but insufficient concentration changes were observed to verify the equation.
W83-03671

8I. Fisheries Engineering

AQUACULTURE TECHNIQUES: A COMPUTER SIMULATION OF AN INTENSIVE FISH CULTURE SYSTEM (AQUA),
Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
G. W. Klontz, J. A. McNair, and T. McArthur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-246405, Price codes: A03 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Moscow, July 1982. 50 p, 18 Ref, 1 Append. A-063-IDA(3), 14-34-0001-0216.

Descriptors: Computer models, *Computer simulation, *Fish hatcheries, Fish management, *Aquaculture, Model studies, *Idaho, Education, *Training.

AQUA is a computer simulation model used for teaching fish culture concepts. In this model, the student functions as a hatchery manager and must program fish growth, monitor pond loadings, treat diseases and make various calculations concerning the interactions of fish, water, container, nutrition and management using a group of rainbow trout. As the student's objective, a product definition is presented at the beginning of the model and is used as a standard for comparison for feedback comments on how well the student 'grew' the fish. A handout containing the necessary equations and information for using AQUA proficiently complements the model to guide inexperienced fish health managers. AQUA is currently being used by students of fish culture and disease at the University of Idaho Department of Fisheries Resources to reinforce and apply concepts taught in the classroom.
W83-03685

9. MANPOWER, GRANTS AND FACILITIES

9D. Grants, Contracts, and Research Act Allotments

EVALUATION OF ALTERNATIVE PROCEDURES FOR REVIEW OF WATER RESOURCES RESEARCH PROPOSALS,
Massachusetts Univ., Amherst. Water Resources Research Center.
B. B. Berger, and E. R. Kaynor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-235325, Price codes: A04, in paper copy, A01 in microfiche. In proceedings, workshop at New England Center for Continuing Education, Durham, NH, June 18-19, 1975. Univ. of Massachusettes, Amherst, September 1975. 59 p, 7 Tab, 3 Appen. OWRT B-061-RI(7), 14-31-0001-3953.

Descriptors: *Research needs, *Research priorities, Funds, *Management planning, Water Research Institutes, *Federal funding, Evaluation, Conferences.

A workshop was held June 18 and 19, 1975 at Durham, New Hampshire to consider the question: given limited funds, how should funding agencies choose among project grant applications. After considering presentations by various Federal agency personnel, participants concluded that methods of evaluating research project grant applications differed extensively in practice, some depending in part on objectified scoring systems, but most depending heavily on qualitative, professional judgment. A University of Massachusetts 'exercise' was also considered. This involved the reactions of two sets of evaluators: 'gut' reactors (practitioners) and 'programmed' reactors (institute directors). Proposals were presented in the form of Office of Water Research and Technology Executive Summaries. While there were obvious limitations connected with this study (too little time, lack of agreement on best evaluation criteria and scaling methods, too few responses, and too limited presentation of proposal substance), study results were still surprising. It appeared to make little difference whether respondents were asked to use judgmental criteria or objective criteria. Perhaps more important, individuals within both groups appeared to differ randomly in their reactions.
W83-03600

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

WATER RESOURCES BIBLIOGRAPHY OF HAWAII,
Hawaii Univ. at Manoa, Honolulu.
F. N. Fujimura, and E. T. Murabayashi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-251066, Price codes: A12 in paper copy, A01 in microfiche. Technical Report No 149, March 1983. 264 p. OWRT A-083-HI(1), 14-34-0001-1113.

Descriptors: *Bibliographies, Water Resources-Center, *Hawaii, *Documentation, Classification, Information exchange, Publications.

The previous Water Resources Research Center bibliographies (Technical Report Nos. 50 and 88) were evaluated by the project staff, assisted by an advisory committee how this bibliography could be improved. As a result of the discussion and evaluation, the order and presentation of the entries in the Annotated Listing were revised. The former three-part code was simplified to a two-part code consisting of the first five letters of the primary author's last name and the last two digits of the year of publication. The title of the report or article is displayed first in bold type form readability, followed successively by the annotation; author(s); keywords; repository, including the call number; and then by the facts of publication, such as the journal name, volume, number, inclusive pages, and the year of publication. Although the original research approach was to include publications issued between 1971 through 1978, earlier as well as more recent publications have been included. Secondary sources of information that were also used in compiling information included the Engineering Index, Selected Water Resources Abstracts, and the Water Resources Scientific Information Center.
W83-03730

SUBJECT INDEX

ACETYLENE REDUCTION
Nitrogen Fixation and Denitrification in the Pamlico River, North Carolina,
W83-03712 5B

ACID MINE DRAINAGE
Oxidation of Ferrous Iron by Acidophilic Iron-Oxidizing Bacteria From a Stream Receiving Acid Mine Drainage,
W83-03541 5B

Evaluation of Acid-Mine-Water Generation and Acid-Mine-Drainage Potential of Coal and Coal-Associated Rocks,
W83-03820 5B

ACID RAIN
Acid Rain: Sources and Effects in Connecticut Report of the Acid Rain Task Force,
W83-03561 2K

Teacher's Resource Guide on Acidic Precipitation with Laboratory Activities,
W83-03565 2K

Effects of Acid Deposition (Rain) on a Piedmont Aquatic Ecosystem: Acid Inputs, Neutralization, and pH Changes,
W83-03700 5C

Effect of Simulated Acid Precipitation on Algal Fixation of Nitrogen and Carbon Dioxide in Forest Soils,
W83-03797 5C

ACIDIC WATER
Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria/F. R. G. 1. Simple Methods for Calculating 'Acidic Aggressiveness' and Carbonate Dissolution Tendency (Kalk-Kohlensaure-Gleicgewicht in Oberflachennahen Grundwassern Nordostbayerns I. Einfache Gleichgewichtsberechnungen Zur 'Saureaggfressivitat' Und Kalklosungstendenz),
W83-03512 2K

Acidification Effects on Macroinvertebrates and Fathead Minnows (Pimephales Promelas) in Outdoor Experimental Channels,
W83-03532 5C

Acid Rain: Sources and Effects in Connecticut Report of the Acid Rain Task Force,
W83-03561 2K

Caco3 Neutralization of Acidified Surface Waters,
W83-03834 5G

ACIDITY
Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria/F. R. G. 1. Simple Methods for Calculating 'Acidic Aggressiveness' and Carbonate Dissolution Tendency (Kalk-Kohlensaure-Gleicgewicht in Oberflachennahen Grundwassern Nordostbayerns I. Einfache Gleichgewichtsberechnungen Zur 'Saureaggfressivitat' Und Kalklosungstendenz),
W83-03512 2K

ACTIVATED CARBON
Removal of Radon from Water Using Granular Activated Carbon Adsorption,
W83-03564 5F

Determination of Biomass MLVSS in Pact Sludges,
W83-03570 5D

The Reactions of Chlorine Disinfectant With Organics Adsorbed on Granular Activated Carbon,
W83-03624 5F

Activated Carbon for Treatment of Cadmium Wastewater,
W83-03825 5D

ACTIVATED SLUDGE
Adaptation of an Activated Sludge Process to the Treatment of Coke-Plant Wastewater Containing High Levels of Cyanide,
W83-03710 5D

ACTIVATED SLUDGE PROCESS
The Adsorption of Bovine Serum Albumin by Activated Sludge,
W83-03533 5D

Measurement and Validity of Oxygen Uptake as an Activated Sludge Process Control Parameter,
W83-03569 5D

Determination of Biomass MLVSS in Pact Sludges,
W83-03570 5D

Variables Affecting Metal Removal from Sludge,
W83-03581 5E

Atmospheric Release of Chlorinated Organic Compounds from the Activated Sludge Process,
W83-03583 5D

Anaerobic Digestion of Waste Activated Sludge,
W83-03827 5D

Clarification Failure Control Strategies,
W83-03828 5D

ACTIVATED SLUDGE PROCESSES
Sub-Surface Aerator/Mixing Units.
W83-03763 5D

ADMINISTRATIVE AGENCIES
Administrative Coordination in the Implementation of Agricultural Nonpoint Pollution Controls,
W83-03559 6E

ADSORPTION
The Adsorption of Bovine Serum Albumin by Activated Sludge,
W83-03533 5D

Activated Carbon for Treatment of Cadmium Wastewater,
W83-03825 5D

ADVANCED WASTEWATER TREATMENT
Studies on the Soil Application Treatment of Coking Plant Wastewater (Untersuchungen Zur Bodenbehandlung Von Kokereiabwasser),
W83-03519 5D

AERATION
Sub-Surface Aerator/Mixing Units.
W83-03763 5D

AERATION ZONE
Combined Movement of Groundwaters and Moisture of the Zone of Aeration,
W83-03542 2F

AERATORS
Tests on Aerators: Conclusions Drawn From 500 Clean Water Tests Conducted in 200 Different Sewage Treatment Plants - I Test Procedure (Essais D'Aerateurs Enseignements Tires De 500 Essais En Eu Clair Effectues Dans 200 Stations D'Epuration Differentes - I Methodologie),
W83-03535 5D

AERIAL PHOTOGRAPHY. *COASTAL MARSHES
Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

AGRICULTURAL HYDROLOGY
Agro-Ecological Regions of Western Rajasthan,
W83-03850 2A

AGRICULTURAL RUNOFF
An Institutional Perspective on the Use of Natural Resources and the Irrigation and Nitrate Contamination Problem,
W83-03587 6B

Impact of Snowmelt-Runoff from Agricultural Watersheds on Dissolved Oxygen,
W83-03636 5B

AGRICULTURAL WASTES
Administrative Coordination in the Implementation of Agricultural Nonpoint Pollution Controls,
W83-03559 6E

AGRICULTURAL WATERSHEDS
Agriculture and Water Quality in the Canadian Great Lakes Basin: III. Phosphorus,
W83-03841 5B

AGRICULTURE
Dredged Sediment for Agriculture: Lake Paradise, Mattoon, Illinois,
W83-03558 3F

Salinity and Resource Development Problems in East Kent,
W83-03645 6G

AIR POLLUTION EFFECTS
Solubilization Rate of Atmospheric Particulate Matter and Impact on Water Quality,
W83-03677 5B

Effects of Acid Deposition (Rain) on a Piedmont Aquatic Ecosystem: Acid Inputs, Neutralization, and pH Changes,
W83-03700 5C

AIR-WATER INTERFACES
Acid Rain: Sources and Effects in Connecticut Report of the Acid Rain Task Force,
W83-03561 2K

AIRPORTS
Water Quality of Airport Storm Runoff, Phase II,
W83-03688 5B

ALABAMA
Sampling and Analysis of Industrial Benthic Polynuclear Aromatic Hydrocarbons in Industrialized Urban Watersheds,
W83-03726 5A

ALASKA
Regional Flood Frequency Analysis for Alaska,
W83-03611 2E

Trophic Energetics in Arctic Freshwater Ecosystems,
W83-03621 2L

ALBUMIN
The Adsorption of Bovine Serum Albumin by Activated Sludge,
W83-03533 5D

ALCOHOLS
Preliminary Evaluation of the Pretreatment of Fuel Alcohol Fermentation Stillage Through an Anaerobic Filter,
W83-03664 5D

ALDICARB
An Investigation of the Chemistry of Degradation of Pesticides and Other Serious Organic Contaminants in Drinking Water for Application to Domestic and Community Water Supplies,
W83-03725 5F

ALGAE
A Dynamic Model of the High-Rate Algal-Bacterial Wastewater Treatment Pond,
W83-03534 5D

Nutrient and Multi-Species Criteria Standard for the Chowan River, North Carolina,
W83-03623 5C

Fate of Herbicides in Groundwater and Surface Runoff and Their Biotic Effects on Prairie Potholes,
W83-03682 5B

Effect of Simulated Acid Precipitation on Algal Fixation of Nitrogen and Carbon Dioxide in Forest Soils,
W83-03797 5C

ALGAE HARVESTING
Harvesting of Algae Grown on Raw Sewage,
W83-03737 5D

ALGAL CONTROL
Integration of Management Methods with the Life Cycle and Ecology of the Filamentous Alga, Pithophora,
W83-03680 4A

ALGAL GROWTH
Silica in Lakes: Nutrient Competition, Equilibrium Reactions in Sediment Pore Waters, and Role in Metal Cycling,
W83-03699 2H

ALGICIDES
Effect of Copper on Nitrogen Fixation and Growth of Blue-Green Algae in Natural Plankton Associations,
W83-03837 5F

ALTERNATIVE PLANNING
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W83-03580 6A

The Feasibility of Engineering-Economic-Management Alternatives for Meeting Water Demands in Tupelo-Lee County, Mississippi,
W83-03722 6D

ALUM COAGULATION
A Systematic Study to Reduce Trihalomethane Precursors in Little Rock Drinking Water by Combined Alum Coagulation/Powdered Activated Carbon Treatment,
W83-03683 5F

AMMONIA
The Freshwater Asian Clam (Corbicula Fluminea) as a Factor Affecting Nutrient Cycling in the Chowan River, N.C.,
W83-03588 5B

Column Design for Recovery of NH3 and CO2 from Wastewater in a Urea Plant,
W83-03748 5D

ANAEROBIC BACTERIA
Preliminary Evaluation of the Pretreatment of Fuel Alcohol Fermentation Stillage Through an Anaerobic Filter,
W83-03664 5D

ANAEROBIC DIGESTION
Preliminary Evaluation of the Pretreatment of Fuel Alcohol Fermentation Stillage Through an Anaerobic Filter,
W83-03664 5D

Anaerobic Digestion of Waste Activated Sludge,
W83-03827 5D

ANTARCTICA
Factors Controlling Phytoplankton in Lake Vanda (77 Degrees S),
W83-03838 2H

ANTECEDENT MOISTURE
Occurrence Probabilities of Antecedent Moisture Condition Classes in Indiana,
W83-03818 2A

APPROPRIATIVE RIGHTS
Water Rights Transfers: A Legal, Economic, and Informational Analysis of Water in Oregon,
W83-03594 6E

APPURTENANT WATER RIGHTS
Water Rights, Water Regulation, and the 'Taking Issue' in Hawaii,
W83-03779 6E

AQUA CULTURE
Harvesting of Algae Grown on Raw Sewage,
W83-03737 5D

AQUACULTURE
Innovative Technology Recycles Waste.
W83-03545 5D

Aquaculture Techniques: A Computer Simulation of an Intensive Fish Culture System (Aqua),
W83-03685 8I

AQUATIC HABITATS
Conservation Aspects of Two River Improvement Schemes in the River Thames Catchment,
W83-03646 4A

Legal and Institutional Constraints and Opportunities in Wetlands Enhancement,
W83-03692 6E

AQUATIC PLANTS
Fate of Herbicides in Groundwater and Surface Runoff and Their Biotic Effects on Prairie Potholes,
W83-03682 5B

AQUATIC PRODUCTIVITY
Trophic Energetics in Arctic Freshwater Ecosystems,
W83-03621 2L

Fate of Herbicides in Groundwater and Surface Runoff and Their Biotic Effects on Prairie Potholes,
W83-03682 5B

AQUATIC WEED CONTROL
Hydrilla Management in North Carolina.
W83-03616 4A

AQUATIC WEEDS
Hydrilla Management in North Carolina.
W83-03616 4A

AQUIFER
Estimating Mixing in Aquifers by Temperature Distribution,
W83-03605 2F

AQUIFER CHARACTERISTICS
An Improved Understanding of Flow in a Limestone Aquifer Using Field Evidence and Mathematical Models,
W83-03578 2F

AQUIFERS
Source Protection - An Ounce of Prevention,
W83-03627 5G

Mineralogical Model of the Floridan Aquifer in the Southwest Florida Water Management District,
W83-03670 2F

Calculations of Seepage Losses of Water Bodies Under the Effect of Infiltration Intakes,
W83-03757 2F

Deep Wells Don't Run Dry,
W83-03810 3B

ARGENTINA
Cu, Cd and Zn in Blanca Bay Surface Sediments, Argentina,
W83-03802 5B

ARID LANDS
Agro-Ecological Regions of Western Rajasthan,
W83-03850 2A

ARID REGIONS
Modern Treatment in the Middle East.
W83-03764 5F

ARID-ZONE HYDROLOGY
A Parametric Model for Peak Flow Prediction in Ungaged Ephemeral Watersheds,
W83-03778 2A

ARIZONA
Estimating Mixing in Aquifers by Temperature Distribution,
W83-03605 2F

Hydrologic Evaluation of Small Impoundments in Arid and Semiarid Regions,
W83-03667 6G

Measurement, Prediction, and Hazard Evaluation of Earth Fissuring and Subsidence Due to Ground-Water Overdraft,
W83-03668 2F

Stable Isotopic Investigation of the Ground Water Quality and Transport Systems in the Safford Valley, Arizona,
W83-03674 2K

Evaporative Cooling by Mist and Sprinkle Irrigation and Conserving Water in Vegetable Irrigation in Arizona,
W83-03729 3F

Water and Energy Conservation in Irrigated Agriculture: An Arid Area Technological and Economic Case Study,
W83-03773 3F

ARKANSAS
A Systematic Study to Reduce Trihalomethane Precursors in Little Rock Drinking Water by Combined Alum Coagulation/Powdered Activated Carbon Treatment,
W83-03683 5F

The Effects of Forest Harvest on Water Quality and Aquatic Life (Phase I),
W83-03686 4D

Chemistry of the Springs of the Ozark Mountains, Northwestern Arkansas,
W83-03707 2K

Factors Affecting the Soluble-Suspended Distribution of Strontium-90 and Cesium-137 in Dardanelle Reservoir, Arkansas,
W83-03795 5B

ARKANSAS RIVER
A Survey of Soils Irrigated With Arkansas River Water,
W83-03589 3C

AROMATIC COMPOUNDS
Investigation of Polycyclic Aromatic Hydrocarbons in Water Systems,
W83-03591 5A

AROMATIC HYDROCARBONS
Isolation, Identification, and Determination of Polycyclic Aromatic Hydrocarbons in Sewage,
W83-03794 5A

ARSENIC
Development of a Chemical Analysis for Ultra-trace Arsenic in Water,
W83-03567 5A

ARTIFICIAL RECHARGE
Artificial Groundwater Recharge, San Luis Valley, Colorado,
W83-03562 4B

Impact of Artificial Recharge on Groundwater Quality of Gypsum Aquifer in Harmon County, Oklahoma,
W83-03607 5B

ASIA
Establishing Water Quality Objectives and Emission Targets in Rivers,
W83-03848 5G

Water Quality Management in Asia: Basic Issues and Priorities,
W83-03849 5G

AUSTRIA
The Weinzodl Power Plant on the Mur (Das Murkraftwerk Weinzodl),
W83-03526 8A

AUTOMATION
On the Methodology of Design and Use of Monitoring and Control Programs for Groundwater Management Facilities (Zur Methodik Des Aufbaus Und Der Nutzung Von Kontroll- Und Steuerungsprogrammen Von Grundwasserfassungsanlagen),
W83-03522 5F

Development of Suitable Closure Specifications for Remote Controlled Ball Valves to Limit Water Hammer in Pipelines of the Zweckverband Landeswasserversorgung Stuttgart (Entwicklung Geeigneter Schliessgesetze Zur Druckstossbegranzung Bei Ferngesteuerten Kugelschiebern In Den Fernwasserleitung Des Zweckverbandes Landeswasserversorgung Stuttgart),
W83-03524 8C

BACTERIA
Bacterial Growth on Ion Exchange Resin - Investigations with a Strong Cationic Exchanger. Part 1: Attachment and Distribution of Bacteria: Operational Possibilities of Supressing Bacterial Growth (Bakterienwachstum Auf Ionenaustauscher-Harz-Untersuchungen an Einem Stark Sauren Kationen-Austauscher. Teil 1: Anhaftung Und Verteilung Der Bakterien; Betriebliche Moglichkeiten Der Wachstums-Unterdruckung),
W83-03507 5F

Coliphages and Coliform Bacteriain Running Waters of Different Quality (Coliphagen und Coliforme Bakterien in Fliessgewassern Unterschiedlicher Gute),
W83-03513 5A

A Dynamic Model of the High-Rate Algal-Bacterial Wastewater Treatment Pond,
W83-03534 5D

The Biodegradation of N-Methyl-2-Pyrrolidone in Water by Sewage Bacteria,
W83-03538 5D

Oxidation of Ferrous Iron by Acidophilic Iron-Oxidizing Bacteria From a Stream Receiving Acid Mine Drainage,
W83-03541 5B

Enterococci and Other Microbial Indicators in Municipal Wastewater Effluents,
W83-03551 5A

Discussion of: Effect of a Bacterial Culture Product on Biological Kinetics,
W83-03571 5D

Enumeration of Chlorine-Damaged Fecal Coliforms in Wastewater Effluents,
W83-03632 5D

BARRIERS
Second Row Molecular Orbital Calculations. 5. A Minimal Basis Indo for Na-Cl,
W83-03613 1B

BAYS
Currents in South San Francisco Bay,
W83-03690 5B

Cu, Cd and Zn in Blanca Bay Surface Sediments, Argentina,
W83-03802 5B

BIBLIOGRAPHIES
Water Resources Bibliography of Hawaii,
W83-03730 10C

BIOASSAY
Methodology of Research Concerning Micropollutants: Biological Tests,
W83-03554 5A

BIOCHEMICAL OXYGEN DEMAND
Filtration of Primary Effluent,
W83-03574 5D

BIODEGRADATION
The Biodegradation of N-Methyl-2-Pyrrolidone in Water by Sewage Bacteria,
W83-03538 5D

Biological Treatability of Specific Organic Compounds Found in Chemical Industry Wastewaters,
W83-03550 5D

BIODISCS
An Innovative Approach of Operating Rotating Biological Contactor Using Pure Oxygen,
W83-03666 5D

BIOFILTERS
Comparative Evaluation of Mathematical Models Used for Calculating Biological Filters,
W83-03735 5D

BIOLOGICAL MEMBRANES
Effect of Polyelectrolytes on Biofilm Growth,
W83-03826 5D

BIOLOGICAL OXYGEN DEMAND
Water pollution Due to Industrial Trout Production in Fish Farms (Gewasserbelastung Durch Industriemassige Forellenproduktion in Rinnenanlagen),
W83-03520 5B

BIOLOGICAL TESTS
Methodology of Research Concerning Micropollutants: Biological Tests,
W83-03554 5A

BIOLOGICAL TREATMENT
Discussion of: Effect of a Bacterial Culture Product on Biological Kinetics,
W83-03571 5D

An Innovative Approach of Operating Rotating Biological Contactor Using Pure Oxygen,
W83-03666 5D

Biological Treatment of Cyanide in High-Strength Coke-Plant Wastewater,
W83-03697 5D

BIOLOGICAL WASTEWATER TREATMENT
The Biodegradation of BIS (Tributyltin) Oxide (TBTO) by Bilogical Sewage Treatment (Der Biologische Abbau Von Tributylzinnoxid (TBTO) in Einer Belebtschlammanlage),
W83-03506 5D

Adaptation of an Activated Sludge Process to the Treatment of Coke-Plant Wastewater Containing High Levels of Cyanide,
W83-03710 5D

Effect of Polyelectrolytes on Biofilm Growth,
W83-03826 5D

BLANEY-CRIDDLE METHOD
Evapotranspiration From Heterogeneous Mountain Meadows,
W83-03684 2D

BONDING
Second Row Molecular Orbital Calculations. 5. A Minimal Basis Indo for Na-Cl,
W83-03613 1B

BOTTOM SEDIMENTS
The Fate, Distribution and Limnological Effects of Volcanic Tephra in the St. Joe and Coeur D'Alene River Deltas of Lake Coeur D'Alene, Idaho,
W83-03597 5B

BOTTOM WATER
The Effects of Bottom Water Anoxia on Benthnic Nutrient Flux Rates in the Pamlico River,
W83-03713 5C

BOUNDARY CONDITIONS
Discussion: Boundary Shear in Smooth and Rough Channels,
W83-03652 8B

BRACKISH LAKES
Environmental Limiting Factors Affecting the Growth and Spread of Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur Lake (Die Umweltfaktoren, Die Die Verbreitung Und Entwicklung Von Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur-See Begrenzen),
W83-03543 5C

BRACKISH WATER
An Evaluation of Seashore Mallow, Kosteletzkya Virginica (L.) Presl., as a Potential New Crop Which Can Be Grown in Brackish Water,
W83-03618 3C

BUBBLE CONCEPT
Here Comes the Water Bubble--Maybe,
W83-03634 5G

CADMIUM
Activated Carbon for Treatment of Cadmium Wastewater,
W83-03825 5D

CALCIUM CARBONATE
Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria/F. R. G. 1. Simple Methods for Calculating 'Acidic Aggressiveness' and Carbonate Dissolution Tendency (Kalk-Kohlensaure-Gleicgewicht in Oberflachennahen Grundwassern Nordostbayerns I. Einfache Gleichgewichtsberechnungen Zur 'Saureaggfressivitat' Und Kalklosungstendenz),
W83-03512 2K

CALIFORNIA
Innovative Technology Recycles Waste.
W83-03545 5D

Dynamic Analysis of Earth Dams in Three Dimensions,
W83-03651 8D

Effect of Copper on Nitrogen Fixation and Growth of Blue-Green Algae in Natural Plankton Associations,
W83-03837 5F

CANADA
Innovative Approaches to Sewage Collection, Treatment, and Disposal: Practices in Northern Canada,
W83-03840 5D

CAPACITY
Research Needs for Capacity Planning,
W83-03639 6D

CARBAMATES
An Investigation of the Chemistry of Degradation of Pesticides and Other Serious Organic

Contaminants in Drinking Water for Application to Domestic and Community Water Supplies, W83-03725 5F

CARBON DIOXIDE
Column Design for Recovery of NH3 and CO2 from Wastewater in a Urea Plant, W83-03748 5D

CARBONIC ACID
Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria. II. Spatial and Temporal Variances (Kalk -Kohlensaure Gleichgewicht in Oberflachennahen Grundwassern Nordostbayerns. II. Zur Hydrochemischen Raumlichen Und Zeitlichen Varianz), W83-03514 2K

CARP
Factors Influencing Dieldrin and DDT Residues in Carp from the Des Moines River, Iowa, 1977-80, W83-03743 5B

CASE STUDIES
Predicting Future Water Demand, W83-03835 6D

CATFISH
Effects on Channel Catfish of High Nitrite Concentrations That Occur in Fish Ponds, W83-03698 5C

CATFISH PONDS
Toxic Effects of Nitrite on Channel Catfish, W83-03709 5C

CEMENTS
Investigation of the Solidification of Wastewater Concentrates with Inorganic Binding Agents (Untersuchungen Uber die Verfestigung von Abwasserkonzentraten mit Anorganischen Bindemitteln), W83-03505 5E

CHANNEL CATFISH
Toxic Effects of Nitrite on Channel Catfish, W83-03709 5C

CHANNEL FLOW
Discussion: Boundary Shear in Smooth and Rough Channels, W83-03652 8B

Discussion: Minimum Specific Energy in Compound Open Channel, W83-03653 8B

CHANNEL IMPROVEMENT
Conservation Aspects of Two River Improvement Schemes in the River Thames Catchment, W83-03646 4A

CHEMICAL ANALYSIS
Development of a Chemical Analysis for Ultratrace Arsenic in Water, W83-03567 5A

Chemistry of the Springs of the Ozark Mountains, Northwestern Arkansas, W83-03707 2K

CHEMICAL COMPOSITION
Chemical Composition of Rain Water Over Lucknow in 1980, W83-03809 2K

CHEMICAL PRECIPITATION
Pilot Plant Experiments on the Physico-Chemical Treatment of Meat Processing Effluents, W83-03792 5D

CHEMICAL PROPERTIES
Acid Rain: Sources and Effects in Connecticut Report of the Acid Rain Task Force, W83-03561 2K

CHEMICAL RECOVERY
Column Design for Recovery of NH3 and CO2 from Wastewater in a Urea Plant, W83-03748 5D

CHEMICAL WASTES
2,3,7,8-Tetrachlorodibenzo-p-Dioxin in Sediment Samples From Love Canal Storm Sewers and Creeks, W83-03814 5A

CHEMISTRY OF PRECIPITATION
Solubilization Rate of Atmospheric Particulate Matter and Impact on Water Quality, W83-03677 5B

Effects of Acid Deposition (Rain) on a Piedmont Aquatic Ecosystem: Acid Inputs, Neutralization, and pH Changes, W83-03700 5C

CHILE
The Nitrogen Balance of Vegetable Crops Irrigated with Untreated Effluent, W83-03745 5B

CHLORAMINES
Chloramines - An Answer to the Trihalomethane Problem, W83-03625 5F

CHLORINATED HYDROCARBONS
Sources of Trihalomethanes and Other C1 and C2 Halo-Organics in Potable Water, W83-03799 5F

CHLORINATION
Enumeration of Chlorine-Damaged Fecal Coliforms in Wastewater Effluents, W83-03632 5D

Sources of Trihalomethanes and Other C1 and C2 Halo-Organics in Potable Water, W83-03799 5F

CHLORINE
The Reactions of Chlorine Disinfectant With Organics Adsorbed on Granular Activated Carbon, W83-03624 5F

Novel Composite Membranes, W83-03678 3A

CHLOROPHYTA
Integration of Management Methods with the Life Cycle and Ecology of the Filamentous Alga, Pithophora, W83-03680 4A

CHOWAN RIVER
The Freshwater Asian Clam (Corbicula Fluminea) as a Factor Affecting Nutrient Cycling in the Chowan River, N.C., W83-03588 5B

CHROMATE
New Correction Procedures for Chromate Interference in the DPD Method for Residual Free and Combined Chlorine in Water, W83-03579 5A

CLAMS
The Freshwater Asian Clam (Corbicula Fluminea) as a Factor Affecting Nutrient Cycling in the Chowan River, N.C., W83-03588 5B

CLARIFICATION
Clarification Failure Control Strategies, W83-03828 5D

CLEARCUTTING
The Effects of Forest Harvest on Water Quality and Aquatic Life (Phase I), W83-03686 4D

CLIMATIC DATA
Variations in Monthly Precipitation Over North Carolina, W83-03598 7C

The Snowy Range Observatory: Climatological and Streamflow Data Report 1982, W83-03675 7C

CLOSED LAKES
Environmental Limiting Factors Affecting the Growth and Spread of Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur Lake (Die Umweltfaktoren, Die Die Verbreitung Und Entwicklung Von Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur-See Begrenzen), W83-03543 5C

COAL
Fine-Coal-Aided Centrifugal Dewatering of Waste Activated Sludge, W83-03659 5E

COASTAL WATERS
Pollution of the Mediterranean Coastal Area (La Pollution Du Littoral De La Mediterranee), W83-03509 5D

Sanitary Monitoring of Seawater in Bathing Areas of France (Surveillance Sanitaire Des Eaux De Baignade En Mer En France), W83-03515 5G

Development of Regional Wetland Restoration Goals: Coastal Wetlands, W83-03691 6G

Restoration Techniques, Research, and Monitoring: Vegetation, W83-03694 2L

COASTAL ZONE MANAGEMENT
Coastal Pollution from Septic Tank Drainfields, W83-03836 5B

COKE-PLANT WASTEWATER
Biological Treatment of Cyanide in High-Strength Coke-Plant Wastewater, W83-03697 5D

COLD REGIONS
Innovative Approaches to Sewage Collection, Treatment, and Disposal: Practices in Northern Canada, W83-03840 5D

COLIFORMS
Sanitary Monitoring of Seawater in Bathing Areas of France (Surveillance Sanitaire Des Eaux De Baignade En Mer En France), W83-03515 5G

The Effect of Stress on Organisms in the Distribution System, W83-03602 5A

Enumeration of Chlorine-Damaged Fecal Coliforms in Wastewater Effluents, W83-03632 5D

The Suitability of M-Endo-LES Agar for Total Coliform Counts by Membrane Filtration, W83-03762 5A

Coastal Pollution from Septic Tank Drainfields, W83-03836 5B

COLLOIDS
The Adsorption of Bovine Serum Albumin by Activated Sludge, W83-03533 5D

COLOR REMOVAL
Enzymatic Pretreatment of Pulp Mill Effluents Prior to Decolorization by Lime Precipitation, W83-03603 5D

COLORADO
Artificial Groundwater Recharge, San Luis Valley, Colorado,
W83-03562 4B

Salt Transport in the Lower South Platte River,
W83-03718 5B

Total Water Management--The Denver Story,
W83-03746 5D

Routing Graded Sediments in Streams: Applications,
W83-03832 2J

COMMUNITY DEVELOPMENT
Stated Financing Policies of Government Agencies and the Experience of Rural Water Supply Systems,
W83-03606 6A

COMPOSITE MEMBRANES
Novel Composite Membranes,
W83-03678 3A

COMPRESSIBILITY
Filtrability and Compressibility of Sludges, Part 1,
W83-03790 5E

COMPUTER APPLICATIONS
Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

COMPUTER MODELS
Artificial Groundwater Recharge, San Luis Valley, Colorado,
W83-03562 4B

COMPUTER PROGRAMS
On the Methodology of Design and Use of Monitoring and Control Programs for Groundwater Management Facilities (Zur Methodik Des Aufbaus Und Der Nutzung Von Kontroll- Und Steuerungsprogrammen Von Grundwasserfassungsanlagen),
W83-03522 5F

A River Basin Network Model for Conjunctive Use of Surface and Groundwater: Program CONSIM,
W83-03596 6A

Simulation of Nutrient, Microorganism, and Heavy Metal Transport Capacity of Suspended Sediment,
W83-03732 2J

Occurrence Probabilities of Antecedent Moisture Condition Classes in Indiana,
W83-03818 2A

COMPUTER SIMULATION
Aquaculture Techniques: A Computer Simulation of an Intensive Fish Culture System (Aqua),
W83-03685 8I

CONFINED AQUIFERS
A Finite Element Model to Predict the Flow of Underground Contaminants Due to Leakage of Chemical and/or Radioactive Material From a Buried Containment,
W83-03672 5B

CONJUNCTIVE USE
A River Basin Network Model for Conjunctive Use of Surface and Groundwater: Program CONSIM,
W83-03596 6A

Institutional Framework for Conjunction Use of Surface and Groundwater in Tupelo-Lee County, Mississippi: Phase II,
W83-03721 4B

The Feasibility of Engineering-Economic-Management Alternatives for Meeting Water Demands in Tupelo-Lee County, Mississippi,
W83-03722 6D

CONNECTICUT
Acid Rain: Sources and Effects in Connecticut Report of the Acid Rain Task Force,
W83-03561 2K

Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

CONSUMPTIVE USE
Effect of Mowing Height Upon Consumptive Water Use, Groundwater Recharge and Recharge Quality from Bermudagrass Watered with Secondary Treated Effluent,
W83-03816 4B

CONTROL SYSTEMS
Lake Weir Designed to Resist Ice Damage,
W83-03681 8A

CONVEYANCE STRUCTURES
Preferred Solutions and Development Trends for Wastewater Conveyance in Drainage Networks (Vorzugslosungen Und Entwicklungstendenzen Der Abwasserforderung in Entwasserungsnetzen),
W83-03517 5D

Development of Suitable Closure Specifications for Remote Controlled Ball Valves to Limit Water Hammer in Pipelines of the Zweckverband Landeswasserversorgung Stuttgart (Entwicklung Geeigneter Schliessgesetze Zur Druckstossbegranzung Bei Ferngesteuerten Kugelschiebern In Den Fernwasserleitung Des Zweckverbandes Landeswasserversorgung Stuttgart),
W83-03524 8C

COOLING PONDS
Levels of Nonpolar Organic Compounds in the Columbia Generating Station Cooling Pond,
W83-03717 5C

COOLING WATER
Biological Problems in Cooling Water Circulation (Biologische Probleme im Kuhlwasserkreislauf),
W83-03528 5B

COPPER
Organically-Bound Copper in Lake and River Waters in Japan,
W83-03536 5B

Effect of Copper on Nitrogen Fixation and Growth of Blue-Green Algae in Natural Plankton Associations,
W83-03837 5F

CORROSION
The Interior Surface of Galvanized Steel Pipe: A Potential Factor in Corrosion Resistance,
W83-03650 8G

A Study of the Occurrence of Hydrogen Sulfide in Sewers in the Piedmont Area of South Carolina,
W83-03671 8G

COST-BENEFIT ANALYSIS
Economic Research Needs Relevant to Improved Drinking Water Quality,
W83-03637 6B

COST SHARING
Inquiry into Tax gains for Members of Partnerships (Steuerliche Gewinnermittlung Bei Partnerwerken),
W83-03530 6C

COSTS
Growth of the Municipal Water System in Ciudad Juarez, Mexico,
W83-03502 5F

The Estimation and Application of the Demand for Discharge Within the Context of Water Quality Management Systems,
W83-03701 6F

Natural Gas Proves to be Economical for Pumping Water,
W83-03715 8C

COUPLED TRANSPORT
Industrial Water Reuse with Coupled-Transport Membranes,
W83-03604 5D

CROP PRODUCTION
Dredged Sediment for Agriculture: Lake Paradise, Mattoon, Illinois,
W83-03558 3F

Water-Use Production Functions of Selected Agronomic Crops in Northwestern New Mexico, Phase II,
W83-03560 2D

CROP RESPONSE
Evaporative Cooling by Mist and Sprinkle Irrigation and Conserving Water in Vegetable Irrigation in Arizona,
W83-03729 3F

CROP YIELD
Statistical Analysis of Crop Yield Controlled Line-Source Irrigation,
W83-03753 3F

CRUSTACEANS
Population Biology in Small Hawaiian Streams,
W83-03676 6G

CULTURES
Discussion of: Effect of a Bacterial Culture Product on Biological Kinetics,
W83-03571 5D

CURRENT METERS
Currents in South San Francisco Bay,
W83-03690 5B

CYANIDE
Biological Treatment of Cyanide in High-Strength Coke-Plant Wastewater,
W83-03697 5D

Adaptation of an Activated Sludge Process to the Treatment of Coke-Plant Wastewater Containing High Levels of Cyanide,
W83-03710 5D

CYANOPHYTA
Factors Regulating Nuisance Blue-Green Algal Bloom Potentials in the Lower Neuse River, N.C.,
W83-03566 5C

Kinetics of Phosphorus Uptake in the Chowan River, North Carolina,
W83-03711 5B

Effect of Copper on Nitrogen Fixation and Growth of Blue-Green Algae in Natural Plankton Associations,
W83-03837 5F

CYCLING NUTRIENTS
The Freshwater Asian Clam (Corbicula Fluminea) as a Factor Affecting Nutrient Cycling in the Chowan River, N.C.,
W83-03588 5B

Kinetics of Phosphorus Uptake in the Chowan River, North Carolina,
W83-03711 5B

The Effects of Bottom Water Anoxia on Benthnic Nutrient Flux Rates in the Pamlico River,
W83-03713 5C

Significance of Floodplain Sediments in Nutrient Exchange Between a Stream and its Floodplain,
W83-03724 2H

CYCLONES
Use of Hydrocyclones to Treat Seafood-Processing Wastewaters,
W83-03572 5D

CZECHOSLOVAKIA
Biological Problems in Cooling Water Circulation (Biologische Probleme im Kuhlwasserkreislauf),
W83-03528 5B

DAM CONSTRUCTION
The Weinzodl Power Plant on the Mur (Das Murkraftwerk Weinzodl),
W83-03526 8A

DAM EFFECTS
Macroinvertebrate Colonization of Multiplate Samplers in the Ohio River: The Effect of Dams,
W83-03824 6G

DAM STABILITY
Dynamic Analysis of Earth Dams in Three Dimensions,
W83-03651 8D

DATA COLLECTIONS
Development and Construction of a Stationary Measuring System for Limnological Observations on the Ammersee (Entwicklung Und Bau Eines Stationaren Messsystems Fur Limnologische Beobachtungen Auf Dem Ammersee),
W83-03527 7B

The Snowy Range Observatory: Climatological and Streamflow Data Report 1982,
W83-03675 7C

DATA INTERPRETATION
Development and Construction of a Stationary Measuring System for Limnological Observations on the Ammersee (Entwicklung Und Bau Eines Stationaren Messsystems Fur Limnologische Beobachtungen Auf Dem Ammersee),
W83-03527 7B

DATA TRANSMISSION
A Signal Recording and Printing System for Telemetering Raingauges,
W83-03801 7B

DDT
Factors Influencing Dieldrin and DDT Residues in Carp from the Des Moines River, Iowa, 1977-80,
W83-03743 5B

DEBRIS FLOW
Hydraulics of Solving Unsteady Debris Flows,
W83-03608 8B

DECISION MAKING
How Much Preventive Maintenance is too Much,
W83-03638 5D

Research Needs for Water Supply Cost Estimating,
W83-03648 6B

DEGRADATION
Removal Mechanisms for Toxic Priority Pollutants,
W83-03647 5D

DELAWARE
The Effect of Stress on Organisms in the Distribution System,
W83-03602 5A

DENITRIFICATION
Discussion of: Industrial Wastes as Carbon Sources in Biological Denitrification,
W83-03576 5D

Nitrogen Fixation and Denitrification in the Pamlico River, North Carolina,
W83-03712 5B

Rate of Denitrification in Water Bodies of an Irrigation System and Soil of Rice Fields in the Kara Kalpuk ASSR,
W83-03760 5B

Compact Nitrogen Removal Options for Lake Como,
W83-03793 5D

DESALINATION
RO vs. MSF for High-Capacity Seawater Desalination Plants,
W83-03622 3A

Novel Composite Membranes,
W83-03678 3A

Modern Treatment in the Middle East.
W83-03764 5F

DESIGN CRITERIA
The Mechanical and Electrical Aspects of the Remodeling of Kempton Park Works,
W83-03586 8C

A Question of Sampling,
W83-03595 7B

DETENTION RESERVOIRS
Technology Transfer Program: Urban Stormwater Management Implementation in Iowa,
W83-03696 4A

DETERGENTS
Removal of Nitrilotriacetic Acid During Primary Sedimentation and Its Effect on Metal Removal,
W83-03813 5D

DETRITUS
Preferred Solutions and Development Trends for Wastewater Conveyance in Drainage Networks (Vorzugslosungen Und Entwicklungstendenzen Der Abwasserforderung in Entwasserungsnetzen),
W83-03517 5D

Trophic Energetics in Arctic Freshwater Ecosystems,
W83-03621 2L

Caco3 Neutralization of Acidified Surface Waters,
W83-03834 5G

DEVELOPING COUNTRIES
The Comprehensive Water Quality Management Program for the Laguna De Bay in the Philippines,
W83-03843 5G

Indices for Water Quality Assessment in Rivers: A Case Study of the Linggi River in Malaysia,
W83-03844 5A

Establishing Water Quality Objectives and Emission Targets in Rivers,
W83-03848 5G

Water Quality Management in Asia: Basic Issues and Priorities,
W83-03849 5G

DEWATERING
Fine-Coal-Aided Centrifugal Dewatering of Waste Activated Sludge,
W83-03659 5E

Magnesium Recycling by Carbonation and Centrifugation of High-Lime Wastewater Sludge,
W83-03660 5E

Development of a Regional Sludge Dewatering Facility Using Pressure Filters,
W83-03661 5E

Harvesting of Algae Grown on Raw Sewage,
W83-03737 5D

Filtrability and Compressibility of Sludges, Part 1,
W83-03790 5E

DEWPOINT
A Dew-Point Hygrometer for Field Use,
W83-03796 7B

DIAGNESIS
Mineralogical Model of the Floridan Aquifer in the Southwest Florida Water Management District,
W83-03670 2F

DIATOMS
Silica in Lakes: Nutrient Competition, Equilibrium Reactions in Sediment Pore Waters, and Role in Metal Cycling,
W83-03699 2H

Diatoms of Lake of the Ozarks, Missouri,
W83-03723 2H

DIELDRIN
Factors Influencing Dieldrin and DDT Residues in Carp from the Des Moines River, Iowa, 1977-80,
W83-03743 5B

DIKES
Engineering Wetlands: Circulation, Sedimentation, and Water Quality,
W83-03693 2L

DINITROGEN
Seasonal Losses of N sub 2, H sub 2S and CH sub 4 from Sediments to the Atmosphere from Wetlands in the Arrowwood National Wildlife Refuge, North Dakota,
W83-03719 5A

DIOXIN
2,3,7,8-Tetrachlorodibenzo-p-Dioxin in Sediment Samples From Love Canal Storm Sewers and Creeks,
W83-03814 5A

DIRECT AQUEOUS INJECTION
A Systematic Study to Reduce Trihalomethane Precursors in Little Rock Drinking Water by Combined Alum Coagulation/Powdered Activated Carbon Treatment,
W83-03683 5F

DISINFECTION
Micropollutants Produced by Disinfection of Wastewater Effluents,
W83-03546 5D

DISPERSION
Dispersion in the Inclined Plane Model of Trickling Filters,
W83-03537 5D

Movement of Salt and Hazardous Contaminants in Groundwater Systems,
W83-03619 5B

Hydrodynamic Dispersion Involving Cationic Adsorption During Unsaturated, Transient Water Flow in Soil,
W83-03749 2G

DISPERSION COEFFICIENT
Impact of Artificial Recharge on Groundwater Quality of Gypsum Aquifer in Harmon County, Oklahoma,
W83-03607 5B

DISSOLVED AIR FLOTATION
Treatment of Raw Wastewater Overflows by Dissolved-Air Flotation,
W83-03575 5D

DISSOLVED OXYGEN
Evaluation of a Dissolved Oxygen Field Test Protocol,
W83-03631 7B

Impact of Snowmelt-Runoff from Agricultural Watersheds on Dissolved Oxygen,
W83-03636 5B

DISTRICT OF COLUMBIA
Predicting Future Water Demand,
W83-03835 6D

DOCTRINE OF PRIOR APPROPRIATION
Water Rights Transfers: A Legal, Economic, and Informational Analysis of Water in Oregon,
W83-03594 6E

DOCUMENTATION
Water Resources Bibliography of Hawaii,
W83-03730 10C

DOMESTIC WATER
Discussion: Residential Water Conservation,
W83-03658 3D

DPD METHOD
New Correction Procedures for Chromate Interference in the DPD Method for Residual Free and Combined Chlorine in Water,
W83-03579 5A

DRAINAGE SYSTEMS
Preferred Solutions and Development Trends for Wastewater Conveyance in Drainage Networks (Vorzugslosungen Und Entwicklungstendenzen Der Abwasserforderung in Entwasserungsnetzen),
W83-03517 5D

DREDGING
Maintenance Dredging in the Port of Bristol,
W83-03539 8C

Dredged Sediment for Agriculture: Lake Paradise, Mattoon, Illinois,
W83-03558 3F

DRINKING WATER
The Mid-Term Extension Program for the Bodensee-Wasserversorgung (Der Mittelfristige Ausbau Der Bodensee-Wasserversorgung),
W83-03523 5F

Development of a Chemical Analysis for Ultratrace Arsenic in Water,
W83-03567 5A

Economic Research Needs Relevant to Improved Drinking Water Quality,
W83-03637 6B

DRIP IRRIGATION
Optimum Water Use In Fruit Crop Production,
W83-03669 3F

DROUGHT
A Study of Low Flows Using Data From the Severn and Trent Catchments. Part II: Flow Frequency Procedures,
W83-03656 2E

The Effect of Excess and Limited Soil Moisture on Nitrogen Fixation of Several Leguminous Crops,
W83-03687 2I

DROUGHT RESISTANCE
Select Hardy Pasture for Drought Surival.
W83-03789 3F

DRY FARMING
Salt Status of Glacial Till Soils of North-Central Montana as Affected by the Crop-Fallow System of Dryland Farming,
W83-03769 2G

Probabiliity Analysis of Short Period Rainfall in Dry Farming Tract in India,
W83-03800 2B

DYE RELEASE
A Review of the Use of Dyes as Soil Water Tracers,
W83-03736 2G

DYES
Studies in Dye-Tracing Techniques and Karst Hydrogeology,
W83-03599 5B

DYNAMIC PROGRAMMING
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W83-03580 6A

E. COLI
Movement of Bacteria Through Macropores to Ground Water,
W83-03705 5B

EARTH DAMS
Dynamic Analysis of Earth Dams in Three Dimensions,
W83-03651 8D

EARTHQUAKES
Dynamic Analysis of Earth Dams in Three Dimensions,
W83-03651 8D

ECONOMETRICS
Water Rights Transfers: A Legal, Economic, and Informational Analysis of Water in Oregon,
W83-03594 6E

ECONOMIC ASPECTS
Inquiry into Tax gains for Members of Partnerships (Steuerliche Gewinnermittlung Bei Partnerwerken),
W83-03530 6C

An Institutional Perspective on the Use of Natural Resources and the Irrigation and Nitrate Contamination Problem,
W83-03587 6B

ECONOMIC EFFICIENCY
Water and Energy Conservation in Irrigated Agriculture: An Arid Area Technological and Economic Case Study,
W83-03773 3F

ECONOMIC EVALUATION
Economic Research Needs Relevant to Improved Drinking Water Quality,
W83-03637 6B

EDUCATION
Teacher's Resource Guide on Acidic Precipitation with Laboratory Activities,
W83-03565 2K

EFFLUENT CHARGES
The Estimation and Application of the Demand for Discharge Within the Context of Water Quality Management Systems,
W83-03701 6F

EFFLUENT LIMITATION
Industrial Wastewater Pretreatment Standards--A Local Approach,
W83-03765 6F

EFFLUENT LIMITATIONS
Here Comes the Water Bubble--Maybe,
W83-03634 5G

EFFLUENT RECHARGE
Organic Micropollutants in Effluent Recharge to Groundwater,
W83-03553 5B

ELECTROPLATING
Activated Carbon for Treatment of Cadmium Wastewater,
W83-03825 5D

ENERGY
Discussion: Minimum Specific Energy in Compound Open Channel,
W83-03653 8B

ENGLAND
Maintenance Dredging in the Port of Bristol,
W83-03539 8C

Organic Micropollutants in Effluent Recharge to Groundwater,
W83-03553 5B

An Improved Understanding of Flow in a Limestone Aquifer Using Field Evidence and Mathematical Models,
W83-03578 2F

The History of Waste Detection in Severn-Trent Water Authority's Derwent Division,
W83-03654 5F

Sources of Trihalomethanes and Other C1 and C2 Halo-Organics in Potable Water,
W83-03799 5F

ENTEROCOCCI
Enterococci and Other Microbial Indicators in Municipal Wastewater Effluents,
W83-03551 5A

ENVIRONMENTAL EFFECTS
Conservation Aspects of Two River Improvement Schemes in the River Thames Catchment,
W83-03646 4A

Towards an Overall Strategy in Designing Wetland Restorations,
W83-03695 4D

Macroinvertebrate Colonization of Multiplate Samplers in the Ohio River: The Effect of Dams,
W83-03824 6G

ENVIRONMENTAL QUALITY
Environmental Quality Standards--New Problems for the Analyst,
W83-03798 5A

ENZYMES
Enzymatic Pretreatment of Pulp Mill Effluents Prior to Decolorization by Lime Precipitation,
W83-03603 5D

EPHEMERAL STREAMS
A Parametric Model for Peak Flow Prediction in Ungaged Ephemeral Watersheds,
W83-03778 2A

EROSION
Simulation of Nutrient, Microorganism, and Heavy Metal Transport Capacity of Suspended Sediment,
W83-03732 2J

Parameters for Describing Soil Detachment Due to Single Waterdrop Impact,
W83-03750 2J

Animal Feedlot Runoff in the Piedmont,
W83-03775 5B

Surface Soil Physical Properties After 36 Years of Cropping to Winter Wheat,
W83-03805 2J

ESTUAIES
The Effects of Bottom Water Anoxia on Benthnic Nutrient Flux Rates in the Pamlico River,
W83-03713 5C

ESTUARIES
Biogeochemistry of the Sediments of the Pamlico and Neuse River Estuaries, North Carolina,
W83-03620 2L

Mineralogy of Sediments in Three Estuaries on Oahu, Hawaii,
W83-03728 2L

Metal Surveys in South African Estuaries V. Kromme and Gamtoos River (St. Francis Bay),
W83-03738 5B

Metal Surveys in South African Estuaries VI. Sundays River,
W83-03739 5B

EUROPE
Environmental Quality Standards--New Problems for the Analyst,
W83-03798 5A

EUTROPHICATION
Factors Regulating Nuisance Blue-Green Algal Bloom Potentials in the Lower Neuse River, N.C.,
W83-03566 5C

Nutrient and Multi-Species Criteria Standard for the Chowan River, North Carolina,
W83-03623 5C

Reservoir Eutrophication and Management,
W83-03629 5G

Kinetics of Phosphorus Uptake in the Chowan River, North Carolina,
W83-03711 5B

EVAPORATION
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

A 'Micro-Lysimter' Method for Determining Evaporation From Bare Soil: Description and Laboratory Evaluation,
W83-03783 2D

EVAPORATIVE COOLING
Evaporative Cooling by Mist and Sprinkle Irrigation and Conserving Water in Vegetable Irrigation in Arizona,
W83-03729 3F

EVAPOTRANSPIRATION
Water-Use Production Functions of Selected Agronomic Crops in Northwestern New Mexico, Phase II,
W83-03560 2D

Water Balance of the Pearl Harbor-Honolulu Basin, Hawaii, 1946-1975,
W83-03673 4B

Evapotranspiration From Heterogeneous Mountain Meadows,
W83-03684 2D

Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

FATE OF POLLUTANTS
The Impact of Urbanization on a Flood-Plain Aquifer: Bloomington, Indiana,
W83-03609 5B

Solubilization Rate of Atmospheric Particulate Matter and Impact on Water Quality,
W83-03677 5B

Fate of Herbicides in Groundwater and Surface Runoff and Their Biotic Effects on Prairie Potholes,
W83-03682 5B

Silicones in Chesapeake Bay Sediments,
W83-03804 5B

Pollutant Loading Model for Highway Runoff,
W83-03829 5B

FATHEAD MINNOWS
Acidification Effects on Macroinvertebrates and Fathead Minnows (Pimephales Promelas) in Outdoor Experimental Channels,
W83-03532 5C

FEDERAL FUNDING
Evaluation of Alternative Procedures for Review of Water Resources Research Proposals,
W83-03600 9D

FEDERAL REPUBLIC OF GERMANY
Hydrogeochemical Investigations with Regard to the Origin of Heavy Metals in Groundwater (Hydrogeochemische Untersuchungen Zur Herkunft Von Schwermetallen Im Grundwasser),
W83-03511 2K

Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria/F. R. G. 1. Simple Methods for Calculating 'Acidic Aggressiveness' and Carbonate Dissolution Tendency (Kalk-Kohlensaure-Gleicgewicht in Oberflachennahen Grundwassern Nordostbayerns I. Einfache Gleichgewichtsberechnungen Zur 'Saureaggfressivitat' Und Kalklosungstendenz),
W83-03512 2K

Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria. II. Spatial and Temporal Variances (Kalk -Kohlensaure Gleichgewicht in Oberflachennahen Grundwassern Nordostbayerns. II. Zur Hydrochemischen Raumlichen Und Zeitlichen Varianz),
W83-03514 2K

Results of Lake Cleanup in the Order-Havel Catchment Areas (Ergebnisse Der Seesanierung Aus Dem Einzugsgebiet Der Wwd Order-Havel),
W83-03516 5G

The Mid-Term Extension Program for the Bodensee-Wasserversorgung (Der Mittelfristige Ausbau Der Bodensee-Wasserversorgung),
W83-03523 5F

Development of Suitable Closure Specifications for Remote Controlled Ball Valves to Limit Water Hammer in Pipelines of the Zweckverband Landeswasserversorgung Stuttgart (Entwicklung Geeigneter Schliessgesetze Zur Druckstossbegranzung Bei Ferngesteuerten Kugelschiebern In Den Fernwasserleitung Des Zweckverbandes Landeswasserversorgung Stuttgart),
W83-03524 8C

Development and Construction of a Stationary Measuring System for Limnological Observations on the Ammersee (Entwicklung Und Bau Eines Stationaren Messsystems Fur Limnologische Beobachtungen Auf Dem Ammersee),
W83-03527 7B

A Method To Compute River Heating - Application to the Management of Thermal Loadings to the Rhine River (Une Methode De Calcul De L'Echauffement Des Rivieres - Application a La Gestion Des Rejets Themiques Au Rhin),
W83-03584 5G

FEEDLOT RUNOFF
Animal Feedlot Runoff in the Piedmont,
W83-03775 5B

FIELD TESTS
Direct Measurements of Secondary Currents in Natural Meander (Direktmessung Von Sekundarstromungen In Natuerlichen Maandern),
W83-03525 2E

FILTER
Preliminary Evaluation of the Pretreatment of Fuel Alcohol Fermentation Stillage Through an Anaerobic Filter,
W83-03664 5D

FILTERS
Filtration of Primary Effluent,
W83-03574 5D

Disposal of Household Wastewater in Soils of High Stone Content,
W83-03679 5D

FILTERS *WASTEWATER TREATMENT
The Use of Field Crop Residues for Sand Filter Modification of Small Community Wastewater Stabilization Ponds to Meet Secondary Treatment Requirements and Recovery of Plant Nutrient Resources,
W83-03665 5D

FILTRATION
Filtration of Primary Effluent,
W83-03574 5D

The Use of Field Crop Residues for Sand Filter Modification of Small Community Wastewater Stabilization Ponds to Meet Secondary Treatment Requirements and Recovery of Plant Nutrient Resources,
W83-03665 5D

Filtrability and Compressibility of Sludges, Part 1,
W83-03790 5E

FINANCING
Research Needs for Water Supply Cost Estimating,
W83-03648 6B

Irrigation Funding Now More Rational,
W83-03811 6F

FINITE ELEMENT METHOD
A Finite Element Model to Predict the Flow of Underground Contaminants Due to Leakage of Chemical and/or Radioactive Material From a Buried Containment,
W83-03672 5B

FISH
Concentration of Heavy Metals in Fishes from the River Danube (Schwermetallgehalt von Fischen aus der Donau),
W83-03504 5C

Acidification Effects on Macroinvertebrates and Fathead Minnows (Pimephales Promelas) in Outdoor Experimental Channels,
W83-03532 5C

FISH DISEASES
Effects on Channel Catfish of High Nitrite Concentrations That Occur in Fish Ponds,
W83-03698 5C

FISH ESTABLISHMENT
Environmental Limiting Factors Affecting the Growth and Spread of Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur Lake (Die Umweltfaktoren, Die Die Verbreitung Und Entwicklung Von Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur-See Begrenzen),
W83-03543 5C

FISH FARMS
Water pollution Due to Industrial Trout Production in Fish Farms (Gewasserbelastung Durch Industriemassige Forellenproduktion in Rinnenanlagen),
W83-03520 5B

FISH GENETICS
Population Biology in Small Hawaiian Streams,
W83-03676 6G

FISH HATCHERIES
Aquaculture Techniques: A Computer Simulation of an Intensive Fish Culture System (Aqua),
W83-03685 8I

FISH POPULATIONS
Population Biology in Small Hawaiian Streams,
W83-03676 6G

FISSURES
Measurement, Prediction, and Hazard Evaluation of Earth Fissuring and Subsidence Due to Ground-Water Overdraft,
W83-03668 2F

FLOOD DAMAGE
Interactive Nonstructural Flood-Control Planning,
W83-03831 6F

FLOOD DATA
A Severe Flood in Luni Basin, Western Rajasthan During July 1979--A Case Study,
W83-03808 2E

FLOOD FREQUENCY
Regional Flood Frequency Analysis for Alaska,
W83-03611 2E

FLOOD PEAK
A Parametric Model for Peak Flow Prediction in Ungaged Ephemeral Watersheds,
W83-03778 2A

FLOOD PLAIN MANAGEMENT
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W83-03580 6A

State Options for Nonstructural Flood Risk Management,
W83-03702 6F

Interactive Nonstructural Flood-Control Planning,
W83-03831 6F

FLOOD PLAINS
Significance of Floodplain Sediments in Nutrient Exchange Between a Stream and its Floodplain,
W83-03724 2H

FLOODING
The Effect of Excess and Limited Soil Moisture on Nitrogen Fixation of Several Leguminous Crops,
W83-03687 2I

FLORIDA
Movement of Salt and Hazardous Contaminants in Groundwater Systems,
W83-03619 5B

Mineralogical Model of the Floridan Aquifer in the Southwest Florida Water Management District,
W83-03670 2F

FLOTATION
Batch Flotation Tests: How Useful are They.,
W83-03549 5D

Treatment of Raw Wastewater Overflows by Dissolved-Air Flotation,
W83-03575 5D

Harvesting of Algae Grown on Raw Sewage,
W83-03737 5D

Pilot Plant Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W83-03792 5D

FLOW AUGMENTATION
Use of Ferruginous Groundwaters to Augment Streamflow,
W83-03577 5G

FLOW CHARACTERISTICS
An Improved Understanding of Flow in a Limestone Aquifer Using Field Evidence and Mathematical Models,
W83-03578 2F

Currents in South San Francisco Bay,
W83-03690 5B

FLOW RESISTANCE
Discussion: Flow Resistance in Coarse Gravel Bed Rivers,
W83-03644 8B

FLOW SEPARATION
Separation of Hydraulic Flow Over Topography,
W83-03830 8B

FLOW VELOCITY
Direct Measurements of Secondary Currents in Natural Meander (Direktmessung Von Sekundarstromungen In Natuerlichen Maandern),
W83-03525 2E

FLOW VISCOSITY
Hydraulics of Solving Unsteady Debris Flows,
W83-03608 8B

FLUCTUATIONS
Constant-Flux Infiltration From a Hemispherical Cavity,
W83-03782 2G

FLUID MECHANICS
Performance Improvement with Broad-Crowned Spillways (Leistungssteigerung Breitkroniger Uberfalle),
W83-03518 8A

Development of Suitable Closure Specifications for Remote Controlled Ball Valves to Limit Water Hammer in Pipelines of the Zweckverband Landeswasserversorgung Stuttgart (Entwicklung Geeigneter Schliessgesetze Zur Druckstossbegranzung Bei Ferngesteuerten Kugelschiebern In Den Fernwasserleitung Des Zweckverbandes Landeswasserversorgung Stuttgart),
W83-03524 8C

FLUIDIZED BED PROCESS
Hydrocarbon Removal in a Three-Phase Fluidized Experimental Bed and Modelling of the Process (Epuration Hydrocarbonne en Couche Fluidisee Triphasique Etude Experimentale et Modelisation),
W83-03531 5D

FLUIDIZED BEDS
Hydrocarbon Removal in a Three-Phase Fluidized Experimental Bed and Modelling of the Process (Epuration Hydrocarbonne en Couche Fluidisee Triphasique Etude Experimentale et Modelisation),
W83-03531 5D

FOOD-PROCESSING WASTES
Use of Hydrocyclones to Treat Seafood-Processing Wastewaters,
W83-03572 5D

FOOD WEBS
Trophic Energetics in Arctic Freshwater Ecosystems,
W83-03621 2L

FORECASTING
On the Methodology of Design and Use of Monitoring and Control Programs for Groundwater Management Facilities (Zur Methodik Des Aufbaus Und Der Nutzung Von Kontroll- Und Steuerungsprogrammen Von Grundwasserfassungsanlagen),
W83-03522 5F

A Research Agenda for Municipal Water Demand Forecasting,
W83-03640 6D

FRANCE
Pollution of the Mediterranean Coastal Area (La Pollution Du Littoral De La Mediterranee),
W83-03509 5D

Sanitary Monitoring of Seawater in Bathing Areas of France (Surveillance Sanitaire Des Eaux De Baignade En Mer En France),
W83-03515 5G

Survey of Trihalomethane Levels in Rhone-Alps Water Supplies. Estimates on the Formation of Chloroform in Wastewater Treatment Plants and Swimming Pools,
W83-03540 5B

Methodology for Determining the Presence and Origin of Organic Micropollutants,
W83-03548 5F

FUMIGANTS
1,2-Dibromo-3-Chloropropane Residues in Water in South Carolina, 1970-80,
W83-03744 5B

FUTURE PLANNING
Research Needs for Capacity Planning,
W83-03639 6D

A Research Agenda for Municipal Water Demand Forecasting,
W83-03640 6D

Research Needs for Water Supply Cost Estimating,
W83-03648 6B

Predicting Future Water Demand,
W83-03835 6D

GAGING STATIONS
River Basin Water Quality Monitoring Network Design,
W83-03593 5A

GAMMA RADIATION
Automatic Determination of Snow Cover (Schneedecke Automatisch Erfasst),
W83-03529 7B

GEOCHEMISTRY
Biogeochemistry of the Sediments of the Pamlico and Neuse River Estuaries, North Carolina,
W83-03620 2L

GEOHYDROLOGY
Ground Water Yields and Availability in Fractured Crystalline Rocks, Wake County, North Carolina,
W83-03733 2F

GEOLOGIC FRACTURES
Measurement, Prediction, and Hazard Evaluation of Earth Fissuring and Subsidence Due to Ground-Water Overdraft,
W83-03668 2F

GEOSTATISTICS
Soil Parameters and Sampling Scheme for Characterizing Soil Hydraulic Properties of a Watershed,
W83-03817 2G

GEOTHERMAL STUDIES
Injection and Thermal Breakthrough in Fractured Geothermal Reservoirs,
W83-03585 2F

GERMAN DEMOCRATIC REPUBLIC
Preferred Solutions and Development Trends for Wastewater Conveyance in Drainage Networks (Vorzugslosungen Und Entwicklungstendenzen Der Abwasserforderung in Entwasserungsnetzen),
W83-03517 5D

Performance Improvement with Broad-Crowned Spillways (Leistungssteigerung Breitkroniger Uberfalle),
W83-03518 8A

Water pollution Due to Industrial Trout Production in Fish Farms (Gewasserbelastung Durch Industriemassige Forellenproduktion in Rinnenanlagen),
W83-03520 5B

Economical Water Use and Recovery of Valuable Materials by Means of Ion Exchangers in the Surface Finishing Industry (Wirtschaftliche Wasserverwendung Und Wertstoffruckgewinnung Durch Ionenaustauscher In Der Oberflachenveredelnden Industrie),
W83-03521 3E

On the Methodology of Design and Use of Monitoring and Control Programs for Groundwater Management Facilities (Zur Methodik Des Aufbaus Und Der Nutzung Von Kontroll- Und Steuerungsprogrammen Von Grundwasserfassungsanlagen),
W83-03522 5F

GRAVEL
Discussion: Flow Resistance in Coarse Gravel Bed Rivers,
W83-03644 8B

GREAT LAKES
Agriculture and Water Quality in the Canadian Great Lakes Basin: III. Phosphorus,
W83-03841 5B

GROUNDWATER
Principles for Transboundary Groundwater Pollution Control,
W83-03501 5G

Groundwater Resources of the Texas Rio Grande Basin,
W83-03503 2F

Hydrogeochemical Investigations with Regard to the Origin of Heavy Metals in Groundwater (Hydrogeochemische Untersuchungen Zur Herkunft Von Schwermetallen Im Grundwasser),
W83-03511 2K

Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria/F. R. G. 1. Simple Methods for Calculating 'Acidic Aggressiveness' and Carbonate Dissolution Tendency (Kalk-Kohlensaure-Gleicgewicht in Oberflachennahen Grundwassern Nordostbayerns I. Einfache Gleichgewichtsberechnungen Zur 'Saureaggfressivitat' Und Kalklosungstendenz),
W83-03512 2K

Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria. II. Spatial and Temporal Variances (Kalk -Kohlensaure Gleichgewicht in Oberflachennahen Grundwassern Nordostbayerns. II. Zur Hydrochemischen Raumlichen Und Zeitlichen Varianz),
W83-03514 2K

Organic Micropollutants in Effluent Recharge to Groundwater,
W83-03553 5B

Use of Ferruginous Groundwaters to Augment Streamflow,
W83-03577 5G

Guidelines for Sampling Ground Water,
W83-03582 5A

Movement of Salt and Hazardous Contaminants in Groundwater Systems,
W83-03619 5B

Effect of Seepage from Unlined Municipal Waste Stabilization Lagoons on Chemical Quality of Groundwater in Shallow Aquifers,
W83-03731 5B

Ground Water Yields and Availability in Fractured Crystalline Rocks, Wake County, North Carolina,
W83-03733 2F

GROUNDWATER AVAILABILITY
Geophysical Mapping Techniques for Groundwater Availability, Central Piedmont Province, North Carolina,
W83-03612 3B

Ground Water Yields and Availability in Fractured Crystalline Rocks, Wake County, North Carolina,
W83-03733 2F

GROUNDWATER CONTAMINATION
Evolution of Nitrate Concentrations in Groundwater in the Middle Vaud Region (Switzerland) (Evolution Des Concentrations en Nitrates Des Eaux Souterraines Du Moyen-Pays Vaudois),
W83-03508 5B

Managing the Risk and Liability of Toxic Contamination of Water Supply,
W83-03630 6F

Salt Status of Glacial Till Soils of North-Central Montana as Affected by the Crop-Fallow System of Dryland Farming,
W83-03769 2G

GROUNDWATER DISPERSION
Estimating Mixing in Aquifers by Temperature Distribution,
W83-03605 2F

GROUNDWATER MANAGEMENT
Groundwater Resources of the Texas Rio Grande Basin,
W83-03503 2F

On the Methodology of Design and Use of Monitoring and Control Programs for Groundwater Management Facilities (Zur Methodik Des Aufbaus Und Der Nutzung Von Kontroll- Und Steuerungsprogrammen Von Grundwasserfassungsanlagen),
W83-03522 5F

The Weinzodl Power Plant on the Mur (Das Murkraftwerk Weinzodl),
W83-03526 8A

Source Protection - An Ounce of Prevention,
W83-03627 5G

Groundwater Protection on the Local Level: Integrating the Fragments of Regulation,
W83-03628 5G

A Comparative Evaluation of Ground-Water Management Techniques,
W83-03704 4B

GROUNDWATER MOVEMENT
Combined Movement of Groundwaters and Moisture of the Zone of Aeration,
W83-03542 2F

Injection and Thermal Breakthrough in Fractured Geothermal Reservoirs,
W83-03585 2F

Mineralogical Model of the Floridan Aquifer in the Southwest Florida Water Management District,
W83-03670 2F

Numerical Modeling of Groundwater Flow Processes,
W83-03771 2F

GROUNDWATER POLLUTION
The Impact of Urbanization on a Flood-Plain Aquifer: Bloomington, Indiana,
W83-03609 5B

Engineering and Legal Ramifications of Groundwater Contamination - A Case Study,
W83-03626 5G

A Study of Radium-226 and Radon-222 Concentration in Ground Water Near a Phosphate Mining and Manufacturing Facility with Emphasis on the Hydrogeologic Characteristics of the Area,
W83-03714 5B

GROUNDWATER POTENTIAL
Geophysical Mapping Techniques for Groundwater Availability, Central Piedmont Province, North Carolina,
W83-03612 3B

GROUNDWATER RECHARGE
Artificial Groundwater Recharge, San Luis Valley, Colorado,
W83-03562 4B

Water Balance of the Pearl Harbor-Honolulu Basin, Hawaii, 1946-1975,
W83-03673 4B

Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

Relationships Among Precipitation, Snowmelt, Subsurface Flow, Groundwater Recharge, and Streamflow Generation in the Clear Creek Watershed, Eastern Sierra Nevada,
W83-03822 2A

GROUNDWATER-SURFACE RELATIONS
The Impact of Urbanization on a Flood-Plain Aquifer: Bloomington, Indiana,
W83-03609 5B

GROUNDWATER TEMPERATURE
Estimating Mixing in Aquifers by Temperature Distribution,
W83-03605 2F

GROWTH KINETICS
Silica in Lakes: Nutrient Competition, Equilibrium Reactions in Sediment Pore Waters, and Role in Metal Cycling,
W83-03699 2H

GROWTH RATES
Bacterial Growth on Ion Exchange Resin - Investigations with a Strong Cationic Exchanger. Part 1: Attachment and Distribution of Bacteria: Operational Possibilities of Supressing Bacterial Growth (Bakterienwachstum Auf Ionenaustauscher-Harz-Untersuchungen an Einem Stark Sauren Kationen-Austauscher. Teil 1: Anhaftung Und Verteilung Der Bakterien; Betriebliche Moglichkeiten Der Wachstums-Unterdruckung),
W83-03507 5F

GULFS
Heavy Metal Distribution in Sediments from the Gulf of Catania (Italy),
W83-03803 5B

GYPSUM
Investigation of the Solidification of Wastewater Concentrates with Inorganic Binding Agents (Untersuchungen Uber die Verfestigung von Abwasserkonzentraten mit Anorganischen Bindemitteln),
W83-03505 5E

HALOGENS
Total Organic Halogen (TOX) Concentrations in the West Lafayette Wastewater Treatment Plant Effluent and the Wabash River,
W83-03819 5E

HAWAII
Water Balance of the Pearl Harbor-Honolulu Basin, Hawaii, 1946-1975,
W83-03673 4B

Population Biology in Small Hawaiian Streams,
W83-03676 6G

Water Quality of Airport Storm Runoff, Phase II,
W83-03688 5B

Mineralogy of Sediments in Three Estuaries on Oahu, Hawaii,
W83-03728 2L

Water Resources Bibliography of Hawaii,
W83-03730 10C

Stream-Water Storage in the Ocean Using an Impermeable Membrane,
W83-03772 3B

Water Rights, Water Regulation, and the 'Taking Issue' in Hawaii,
W83-03779 6E

Soil Parameters and Sampling Scheme for Characterizing Soil Hydraulic Properties of a Watershed,
W83-03817 2G

HEAT BALANCE
On the Role of Large Scale Energetics in the Onset and Maintenance of Summer Monsoon--II: Moisture Budget,
W83-03786 2B

HEATED WATER
A Method To Compute River Heating - Application to the Management of Thermal Loadings to the Rhine River (Une Methode De Calcul De L'Echauffement Des Rivieres - Application a La Gestion Des Rejets Themiques Au Rhin),
W83-03584 5G

Growth, Development, and Root Quality of Sweet Potato as Influenced by Soil Warming,
W83-03615 3C

HEAVY METALS
Concentration of Heavy Metals in Fishes from the River Danube (Schwermetallgehalt von Fischen aus der Donau),
W83-03504 5C

Hydrogeochemical Investigations with Regard to the Origin of Heavy Metals in Groundwater (Hydrogeochemische Untersuchungen Zur Herkunft Von Schwermetallen Im Grundwasser),
W83-03511 2K

Land Application of Sewage Sludge Landfill Leachate,
W83-03563 5E

A Preliminary Investigation Into the Use of Crayfish as a Sensitive Species to Pollutants in the Clark Fork River Near Missoula, MT,
W83-03617 5B

Assessment of Heavy Metals and PCBs at Sludge Application Sites,
W83-03633 5E

Chemistry of the Springs of the Ozark Mountains, Northwestern Arkansas,
W83-03707 2K

Heavy Metal Distribution in Sediments from the Gulf of Catania (Italy),
W83-03803 5B

HERBICIDES
Hydrilla Management in North Carolina.
W83-03616 4A

HIGHWAY EFFECTS
Pollutant Loading Model for Highway Runoff,
W83-03829 5B

HISTORY
The Estimation and Application of the Demand for Discharge Within the Context of Water Quality Management Systems,
W83-03701 6F

HUMIDITY
A Dew-Point Hygrometer for Field Use,
W83-03796 7B

HYDRAULIC CONDUCTIVITY
Measuring the Hydraulic Conductivity of Soil Horizons With Continuous Macropores,
W83-03754 2G

Soil Parameters and Sampling Scheme for Characterizing Soil Hydraulic Properties of a Watershed,
W83-03817 2G

HYDRAULIC DESIGN
Performance Improvement with Broad-Crowned Spillways (Leistungssteigerung Breitkroniger Uberfalle),
W83-03518 8A

Technology Transfer Program: Urban Stormwater Management Implementation in Iowa,
W83-03696 4A

HYDRAULIC ENGINEERING
The Weinzodl Power Plant on the Mur (Das Murkraftwerk Weinzodl),
W83-03526 8A

HYDRAULIC EQUIPMENT
Maintenance Dredging in the Port of Bristol,
W83-03539 8C

HYDRAULIC FRICTION
Discussion: Boundary Shear in Smooth and Rough Channels,
W83-03652 8B

HYDRAULIC PROFILES
Performance Improvement with Broad-Crowned Spillways (Leistungssteigerung Breitkroniger Uberfalle),
W83-03518 8A

HYDRAULIC VALVES
Development of Suitable Closure Specifications for Remote Controlled Ball Valves to Limit Water Hammer in Pipelines of the Zweckverband Landeswasserversorgung Stuttgart (Entwicklung Geeigneter Schliessgesetze Zur Druckstossbegranzung Bei Ferngesteuerten Kugelschiebern In Den Fernwasserleitung Des Zweckverbandes Landeswasserversorgung Stuttgart),
W83-03524 8C

HYDROCARBONS
Investigation of Polycyclic Aromatic Hydrocarbons in Water Systems,
W83-03591 5A

Levels of Nonpolar Organic Compounds in the Columbia Generating Station Cooling Pond,
W83-03717 5C

HYDROCYCLONES
Use of Hydrocyclones to Treat Seafood-Processing Wastewaters,
W83-03572 5D

HYDROELECTRIC PLANTS
The Weinzodl Power Plant on the Mur (Das Murkraftwerk Weinzodl),
W83-03526 8A

Inquiry into Tax gains for Members of Partnerships (Steuerliche Gewinnermittlung Bei Partnerwerken),
W83-03530 6C

HYDROGEN SULFIDE
A Study of the Occurrence of Hydrogen Sulfide in Sewers in the Piedmont Area of South Carolina,
W83-03671 8G

Seasonal Losses of N sub 2, H sub 2S and CH sub 4 from Sediments to the Atmosphere from Wetlands in the Arrowwood National Wildlife Refuge, North Dakota,
W83-03719 5A

HYDROGRAPHS
Technology Transfer Program: Urban Stormwater Management Implementation in Iowa,
W83-03696 4A

HYDROLOGIC BUDGET
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

HYDROLOGIC CYCLE
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

HYDROLOGIC DATA
The Snowy Range Observatory: Climatological and Streamflow Data Report 1982,
W83-03675 7C

HYDROLOGIC DATA COLLECTIONS
Currents in South San Francisco Bay,
W83-03690 5B

HYDROLOGY MODELS
Hydrologic Evaluation of Small Impoundments in Arid and Semiarid Regions,
W83-03667 6G

HYDROMETEOROLOGY
Development and Construction of a Stationary Measuring System for Limnological Observations on the Ammersee (Entwicklung Und Bau Eines Stationaren Messsystems Fur Limnologische Beobachtungen Auf Dem Ammersee),
W83-03527 7B

On the Role of Large Scale Energetics in the Onset and Maintenance of Summer Monsoon--II: Moisture Budget,
W83-03786 2B

Hydrometeorological Study of Severe Rainstorms of North Bihar,
W83-03788 2B

HYGROMETERS
A Dew-Point Hygrometer for Field Use,
W83-03796 7B

ICE
Lake Weir Designed to Resist Ice Damage,
W83-03681 8A

IDAHO
The Fate, Distribution and Limnological Effects of Volcanic Tephra in the St. Joe and Coeur D'Alene River Deltas of Lake Coeur D'Alene, Idaho,
W83-03597 5B

IDAHO

Aquaculture Techniques: A Computer Simulation of an Intensive Fish Culture System (Aqua),
W83-03685 8I

ILLINOIS

Dredged Sediment for Agriculture: Lake Paradise, Mattoon, Illinois,
W83-03558 3F

Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W83-03580 6A

IMPAIRED WATER QUALITY

Investigation of Polycyclic Aromatic Hydrocarbons in Water Systems,
W83-03591 5A

IMPOUNDMENTS

Effect of Seepage from Unlined Municipal Waste Stabilization Lagoons on Chemical Quality of Groundwater in Shallow Aquifers,
W83-03731 5B

INCEPTISOL

Mineralogy of Sediments in Three Estuaries on Oahu, Hawaii,
W83-03728 2L

INDIA

On the Role of Large Scale Energetics in the Onset and Maintenance of Summer Monsoon--II: Moisture Budget,
W83-03786 2B

Hydrometeorological Study of Severe Rainstorms of North Bihar,
W83-03788 2B

Probabiliity Analysis of Short Period Rainfall in Dry Farming Tract in India,
W83-03800 2B

A Severe Flood in Luni Basin, Western Rajasthan During July 1979--A Case Study,
W83-03808 2E

Chemical Composition of Rain Water Over Lucknow in 1980,
W83-03809 2K

Agro-Ecological Regions of Western Rajasthan,
W83-03850 2A

INDIANA

The Impact of Urbanization on a Flood-Plain Aquifer: Bloomington, Indiana,
W83-03609 5B

Integration of Management Methods with the Life Cycle and Ecology of the Filamentous Alga, Pithophora,
W83-03680 4A

Occurrence Probabilities of Antecedent Moisture Condition Classes in Indiana,
W83-03818 2A

Total Organic Halogen (TOX) Concentrations in the West Lafayette Wastewater Treatment Plant Effluent and the Wabash River,
W83-03819 5E

INDICATORS

Coliphages and Coliform Bacteriain Running Waters of Different Quality (Coliphagen und Coliforme Bakterien in Fliessgewassern Unterschiedlicher Gute),
W83-03513 5A

Enterococci and Other Microbial Indicators in Municipal Wastewater Effluents,
W83-03551 5A

INDUSTRIAL WASTES

Physico-Chemical Speciation of Selected Metals in the Treated Effluent of a Lead-Acid Battery Manufacturer and in the Receiving River,
W83-03544 5B

A Preliminary Investigation Into the Use of Crayfish as a Sensitive Species to Pollutants in the Clark Fork River Near Missoula, MT,
W83-03617 5B

Preliminary Evaluation of the Pretreatment of Fuel Alcohol Fermentation Stillage Through an Anaerobic Filter,
W83-03664 5D

Sampling and Analysis of Industrial Benthic Polynuclear Aromatic Hydrocarbons in Industrialized Urban Watersheds,
W83-03726 5A

Plastic Pellets on Spain's 'Costa Del Sol' Beaches,
W83-03785 5B

Activated Carbon for Treatment of Cadmium Wastewater,
W83-03825 5D

INDUSTRIAL WASTEWATER

Use of Hydrocyclones to Treat Seafood-Processing Wastewaters,
W83-03572 5D

Column Design for Recovery of NH3 and CO2 from Wastewater in a Urea Plant,
W83-03748 5D

Industrial Wastewater Pretreatment Standards--A Local Approach,
W83-03765 6F

INFILTRATION

Predicting Infiltration and Surface Runoff from Reconstructed Spoils and Soils,
W83-03610 4C

Calculations of Seepage Losses of Water Bodies Under the Effect of Infiltration Intakes,
W83-03757 2F

Trickle Irrigation - Modeling Water and Solutes,
W83-03777 2G

Constant-Flux Infiltration From a Hemispherical Cavity,
W83-03782 2G

INFILTRATION RATE

Predicting Infiltration and Surface Runoff from Reconstructed Spoils and Soils,
W83-03610 4C

Two-Dimensional Exponential Infiltration Equations,
W83-03663 2G

INJECTION WELLS

Injection and Thermal Breakthrough in Fractured Geothermal Reservoirs,
W83-03585 2F

INSTITUTIONAL CONSTRAINTS

Legal and Institutional Constraints and Opportunities in Wetlands Enhancement,
W83-03692 6E

Institutional Framework for Conjunction Use of Surface and Groundwater in Tupelo-Lee County, Mississippi: Phase II,
W83-03721 4B

INSTITUTIONS

The Estimation and Application of the Demand for Discharge Within the Context of Water Quality Management Systems,
W83-03701 6F

INSTREAM FLOW

Instream Flow Requirements for Fish and Fisheries in Maryland,
W83-03776 2E

INTERCEPTOR SEWERS

A Study of the Occurrence of Hydrogen Sulfide in Sewers in the Piedmont Area of South Carolina,
W83-03671 8G

INVERTEBRATES

Acidification Effects on Macroinvertebrates and Fathead Minnows (Pimephales Promelas) in Outdoor Experimental Channels,
W83-03532 5C

Macroinvertebrate Colonization of Multiplate Samplers in the Ohio River: The Effect of Dams,
W83-03824 6G

ION EXCHANGE

Bacterial Growth on Ion Exchange Resin - Investigations with a Strong Cationic Exchanger. Part 1: Attachment and Distribution of Bacteria: Operational Possibilities of Supressing Bacterial Growth (Bakterienwachstum Auf Ionenaustauscher-Harz-Untersuchungen an Einem Stark Sauren Kationen-Austauscher. Teil 1: Anhaftung Und Verteilung Der Bakterien; Betriebliche Moglichkeiten Der Wachstums-Unterdruckung),
W83-03507 5F

Economical Water Use and Recovery of Valuable Materials by Means of Ion Exchangers in the Surface Finishing Industry (Wirtschaftliche Wasserverwendung Und Wertstoffruckgewinnung Durch Ionenaustauscher In Der Oberflachenveredelnden Industrie),
W83-03521 3E

Waste Water Treatment by Ligand Exchange,
W83-03706 5D

An Investigation of the Chemistry of Degradation of Pesticides and Other Serious Organic Contaminants in Drinking Water for Application to Domestic and Community Water Supplies,
W83-03725 5F

IOWA

Technology Transfer Program: Urban Stormwater Management Implementation in Iowa,
W83-03696 4A

Factors Influencing Dieldrin and DDT Residues in Carp from the Des Moines River, Iowa, 1977-80,
W83-03743 5B

IRAN

Water Harvesting for Afforestation: III. Dependence of Tree Growth on Amount and Distribution of Precipitation,
W83-03752 3B

IRON COMPOUNDS

Oxidation of Ferrous Iron by Acidophilic Iron-Oxidizing Bacteria From a Stream Receiving Acid Mine Drainage,
W83-03541 5B

Use of Ferruginous Groundwaters to Augment Streamflow,
W83-03577 5G

IRRIGATED SOILS

A Survey of Soils Irrigated With Arkansas River Water,
W83-03589 3C

IRRIGATION
An Institutional Perspective on the Use of Natural Resources and the Irrigation and Nitrate Contamination Problem,
W83-03587 6B

Heavy Water Tracing of Soil-Water Transfers Under Irrigation,
W83-03755 2G

Irrigation Funding Now More Rational,
W83-03811 6F

IRRIGATION DESIGN
Two-Dimensional Exponential Infiltration Equations,
W83-03663 2G

IRRIGATION EFFECTS
Salt Transport in the Lower South Platte River,
W83-03718 5B

IRRIGATION EFFICIENCY
Optimum Water Use In Fruit Crop Production,
W83-03669 3F

Water and Energy Conservation in Irrigated Agriculture: An Arid Area Technological and Economic Case Study,
W83-03773 3F

IRRIGATION PRACTICES
Statistical Analysis of Crop Yield Controlled Line-Source Irrigation,
W83-03753 3F

Rate of Denitrification in Water Bodies of an Irrigation System and Soil of Rice Fields in the Kara Kalpuk ASSR,
W83-03760 5B

IRRIGATION REQUIREMENTS
Optimum Water Use In Fruit Crop Production,
W83-03669 3F

IRRIGATION WATER
Total Water Management--The Denver Story,
W83-03746 5D

Deep Wells Don't Run Dry,
W83-03810 3B

ISOTOPE STUDIES
Stable Isotopic Investigation of the Ground Water Quality and Transport Systems in the Safford Valley, Arizona,
W83-03674 2K

ITALY
Compact Nitrogen Removal Options for Lake Como,
W83-03793 5D

Heavy Metal Distribution in Sediments from the Gulf of Catania (Italy),
W83-03803 5B

JAPAN
Organically-Bound Copper in Lake and River Waters in Japan,
W83-03536 5B

Oxidation of Ferrous Iron by Acidophilic Iron-Oxidizing Bacteria From a Stream Receiving Acid Mine Drainage,
W83-03541 5B

JUAREZ
Growth of the Municipal Water System in Ciudad Juarez, Mexico,
W83-03502 5F

KADIUM-226
A Study of Radium-226 and Radon-222 Concentration in Ground Water Near a Phosphate Mining and Manufacturing Facility with Emphasis on the Hydrogeologic Characteristics of the Area,
W83-03714 5B

KARST HYDROLOGY
Studies in Dye-Tracing Techniques and Karst Hydrogeology,
W83-03599 5B

KENTUCKY
Studies in Dye-Tracing Techniques and Karst Hydrogeology,
W83-03599 5B

Predicting Infiltration and Surface Runoff from Reconstructed Spoils and Soils,
W83-03610 4C

KINETICS
Discussion of: Effect of a Bacterial Culture Product on Biological Kinetics,
W83-03571 5D

Kinetics of Phosphorus Uptake in the Chowan River, North Carolina,
W83-03711 5B

LAGOONS
Effect of Seepage from Unlined Municipal Waste Stabilization Lagoons on Chemical Quality of Groundwater in Shallow Aquifers,
W83-03731 5B

LAKE ERIE
Monitoring Water Quality Parameters from Municipal Water Intakes,
W83-03568 5F

LAKE SEDIMENTS
Dredged Sediment for Agriculture: Lake Paradise, Mattoon, Illinois,
W83-03558 3F

The Fate, Distribution and Limnological Effects of Volcanic Tephra in the St. Joe and Coeur D'Alene River Deltas of Lake Coeur D'Alene, Idaho,
W83-03597 5B

Caco3 Neutralization of Acidified Surface Waters,
W83-03834 5G

LAKES
Organically-Bound Copper in Lake and River Waters in Japan,
W83-03536 5B

LAND APPLICATION
Assessment of Heavy Metals and PCBs at Sludge Application Sites,
W83-03633 5E

LAND RECLAMATION
Evaluation of Acid-Mine-Water Generation and Acid-Mine-Drainage Potential of Coal and Coal-Associated Rocks,
W83-03820 5B

LAND USE
Technology Transfer Program: Urban Stormwater Management Implementation in Iowa,
W83-03696 4A

State Options for Nonstructural Flood Risk Management,
W83-03702 6F

Water Conservation in Residential Development: Land-Use Techniques,
W83-03716 3D

LANDFILLS
Landfill Management and Leachate Quality,
W83-03812 5E

2,3,7,8-Tetrachlorodibenzo-p-Dioxin in Sediment Samples From Love Canal Storm Sewers and Creeks,
W83-03814 5A

LEACHATES
Land Application of Sewage Sludge Landfill Leachate,
W83-03563 5E

Landfill Management and Leachate Quality,
W83-03812 5E

LEACHING
Investigation of the Solidification of Wastewater Concentrates with Inorganic Binding Agents (Untersuchungen Uber die Verfestigung von Abwasserkonzentraten mit Anorganischen Bindemitteln),
W83-03505 5E

Electromagnetic Determination of Soil Water Content Using TDR: I. Applications to Wetting Fronts and Steep Gradients,
W83-03766 7B

A Modified Line Source Sprinkler Technique for Continuous-Variable Leaching Studies,
W83-03767 3F

LEAD
Toxicity of Organolead Compounds: Study of Bacterial Inactivation by Measurement of ATP (Approche De La Toxicite Des Organo Plombs Etude De L'Inactivation Bacterienne Par Mesures D'ATP),
W83-03510 5C

LEAKAGE
The History of Waste Detection in Severn-Trent Water Authority's Derwent Division,
W83-03654 5F

LEGAL ASPECTS
Principles for Transboundary Groundwater Pollution Control,
W83-03501 5G

Engineering and Legal Ramifications of Groundwater Contamination - A Case Study,
W83-03626 5G

Groundwater Protection on the Local Level: Integrating the Fragments of Regulation,
W83-03628 5G

Managing the Risk and Liability of Toxic Contamination of Water Supply,
W83-03630 6F

Legal and Institutional Constraints and Opportunities in Wetlands Enhancement,
W83-03692 6E

Water Rights, Water Regulation, and the 'Taking Issue' in Hawaii,
W83-03779 6E

LENTIPES CONCOLOR
Population Biology in Small Hawaiian Streams,
W83-03676 6G

LIABILITY
Managing the Risk and Liability of Toxic Contamination of Water Supply,
W83-03630 6F

LIGAND EXCHANGE
Waste Water Treatment by Ligand Exchange,
W83-03706 5D

LIME
Magnesium Recycling by Carbonation and Centrifugation of High-Lime Wastewater Sludge,
W83-03660 5E

LIMNOLOGY
Development and Construction of a Stationary Measuring System for Limnological Observations on the Ammersee (Entwicklung Und Bau

Eines Stationaren Messsystems Fur Limnologische Beobachtungen Auf Dem Ammersee),
W83-03527 7B

The Fate, Distribution and Limnological Effects of Volcanic Tephra in the St. Joe and Coeur D'Alene River Deltas of Lake Coeur D'Alene, Idaho,
W83-03597 5B

LINE-SOURCE IRRIGATION
Statistical Analysis of Crop Yield Controlled Line-Source Irrigation,
W83-03753 3F

LITERATURE REVIEW
Effect of Polyelectrolytes on Biofilm Growth,
W83-03826 5D

LITTLE LARAMIE RIVER VALLEY
Evapotranspiration From Heterogeneous Mountain Meadows,
W83-03684 2D

LOANS
Irrigation Funding Now More Rational,
W83-03811 6F

LOBE PUMPS
Geometric Changes Bring Lobe Pumps into Sewage Sludge Markets.
W83-03742 8C

LOCAL GOVERNMENTS
Water Conservation in Residential Development: Land-Use Techniques,
W83-03716 3D

LONG ISLAND
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

LOW FLOW
A Study of Low Flows Using Data From the Severn and Trent Catchments. Part II: Flow Frequency Procedures,
W83-03656 2E

LOW FLOW AUGMENTATION
Use of Ferruginous Groundwaters to Augment Streamflow,
W83-03577 5G

LYSIMETERS
Studies on the Soil Application Treatment of Coking Plant Wastewater (Untersuchungen Zur Bodenbehandlung Von Kokereiabwasser),
W83-03519 5D

A 'Micro-Lysimter' Method for Determining Evaporation From Bare Soil: Description and Laboratory Evaluation,
W83-03783 2D

MACROPORES
Measuring the Hydraulic Conductivity of Soil Horizons With Continuous Macropores,
W83-03754 2G

MAGNESIUM COMPOUNDS
Magnesium Recycling by Carbonation and Centrifugation of High-Lime Wastewater Sludge,
W83-03660 5E

MAINTENANCE
How Much Preventive Maintenance is too Much,
W83-03638 5D

The Masonry Sewers of Aleppo,
W83-03655 5D

MAINTENANCE COSTS
How Much Preventive Maintenance is too Much,
W83-03638 5D

MALAYSIA
Indices for Water Quality Assessment in Rivers: A Case Study of the Linggi River in Malaysia,
W83-03844 5A

MANAGEMENT
Hydrilla Management in North Carolina.
W83-03616 4A

Institutional Framework for Conjunction Use of Surface and Groundwater in Tupelo-Lee County, Mississippi: Phase II,
W83-03721 4B

Management Model for Power Production From a Geothermal Field: 1. Hot Water Reservoir and Power Plant Model,
W83-03761 8A

MANAGEMENT PLANNING
Evaluation of Alternative Procedures for Review of Water Resources Research Proposals,
W83-03600 9D

MANOMETERS
Seasonal Losses of N sub 2, H sub 2S and CH sub 4 from Sediments to the Atmosphere from Wetlands in the Arrowwood National Wildlife Refuge, North Dakota,
W83-03719 5A

MAPPING
Geophysical Mapping Techniques for Groundwater Availability, Central Piedmont Province, North Carolina,
W83-03612 3B

Agro-Ecological Regions of Western Rajasthan,
W83-03850 2A

MAPS
Variations in Monthly Precipitation Over North Carolina,
W83-03598 7C

MARKETING
The Estimation and Application of the Demand for Discharge Within the Context of Water Quality Management Systems,
W83-03701 6F

MARSH PLANTS
An Evaluation of Seashore Mallow, Kosteletzkya Virginica (L.) Presl., as a Potential New Crop Which Can Be Grown in Brackish Water,
W83-03618 3C

MARSHES
Engineering Wetlands: Circulation, Sedimentation, and Water Quality,
W83-03693 2L

Restoration Techniques, Research, and Monitoring: Vegetation,
W83-03694 2L

MARYLAND
Instream Flow Requirements for Fish and Fisheries in Maryland,
W83-03776 2E

MASONRY SEWERS
The Masonry Sewers of Aleppo,
W83-03655 5D

MASSACHUSETTS
Engineering and Legal Ramifications of Groundwater Contamination - A Case Study,
W83-03626 5G

Source Protection - An Ounce of Prevention,
W83-03627 5G

Groundwater Protection on the Local Level: Integrating the Fragments of Regulation,
W83-03628 5G

Increasing Rockport's Water Supply,
W83-03662 6D

Natural Gas Proves to be Economical for Pumping Water,
W83-03715 8C

MATHEMATICAL EQUATIONS
Dispersion in the Inclined Plane Model of Trickling Filters,
W83-03537 5D

MATHEMATICAL MODELS
Hydrocarbon Removal in a Three-Phase Fluidized Experimental Bed and Modelling of the Process (Epuration Hydrocarbonne en Couche Fluidisee Triphasique Etude Experimentale et Modelisation),
W83-03531 5D

Artificial Groundwater Recharge, San Luis Valley, Colorado,
W83-03562 4B

A Method To Compute River Heating - Application to the Management of Thermal Loadings to the Rhine River (Une Methode De Calcul De L'Echauffement Des Rivieres - Application a La Gestion Des Rejets Themiques Au Rhin),
W83-03584 5G

A Finite Element Model to Predict the Flow of Underground Contaminants Due to Leakage of Chemical and/or Radioactive Material From a Buried Containment,
W83-03672 5B

Comparative Evaluation of Mathematical Models Used for Calculating Biological Filters,
W83-03735 5D

Path of a Vortex in a Semi-Infinite Region With a Streaming Motion along a Plane Wall Boundary Having a Semicircular Bay or Bulge,
W83-03807 2E

Anaerobic Digestion of Waste Activated Sludge,
W83-03827 5D

MATHEMATICAL STUDIES
Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria/F. R. G. 1. Simple Methods for Calculating 'Acidic Aggressiveness' and Carbonate Dissolution Tendency (Kalk-Kohlensaure-Gleicgewicht in Oberflachennahen Grundwassern Nordostbayerns I. Einfache Gleichgewichtsberechnungen Zur 'Saureaggfressivitat' Und Kalklosungstendenz),
W83-03512 2K

Constant-Flux Infiltration From a Hemispherical Cavity,
W83-03782 2G

MAURITIUS
An Analysis of Mauritian Winter Rainfall,
W83-03787 2B

MEANDERS
Direct Measurements of Secondary Currents in Natural Meander (Direktmessung Von Sekundarstromungen In Natuerlichen Maandern),
W83-03525 2E

MEASURING INSTRUMENTS
Development and Construction of a Stationary Measuring System for Limnological Observations on the Ammersee (Entwicklung Und Bau Eines Stationaren Messsystems Fur Limnologische Beobachtungen Auf Dem Ammersee),
W83-03527 7B

Automatic Determination of Snow Cover (Schneedecke Automatisch Erfasst),
W83-03529 7B

A Question of Sampling,
W83-03595 7B

Evaluation of a Dissolved Oxygen Field Test Protocol,
W83-03631 7B

Discussion: Long-Term Performance of Embankment Dam Instrumentation,
W83-03642 8G

Discussion: Piezometers in Earth Dam Impervious Sections,
W83-03643 8G

Factors Affecting Stress Cell Measurements in Soil,
W83-03657 8D

Hydrochemical Methods of Investigating Production and Destruction Processes in Natural Waters,
W83-03756 2H

A Permeameter Which Eliminates Boundary Flow Errors in Saturated Hydraulic Conductivity Measurements,
W83-03770 7B

A 'Micro-Lysimter' Method for Determining Evaporation From Bare Soil: Description and Laboratory Evaluation,
W83-03783 2D

Electromagnetic Determination of Soil Water Content Using TDR: II. Evaluation of Installation and Configuration of Parallel Transmission Lines,
W83-03806 7B

MEAT PROCESSING INDUSTRY
Pilot Plant Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W83-03792 5D

MEDITERRANEAN SEA
Pollution of the Mediterranean Coastal Area (La Pollution Du Littoral De La Mediterranee),
W83-03509 5D

MEDITTERRANEAN SEA
Sanitary Monitoring of Seawater in Bathing Areas of France (Surveillance Sanitaire Des Eaux De Baignade En Mer En France),
W83-03515 5G

MEMBRANE FILTRATION
The Suitability of M-Endo-LES Agar for Total Coliform Counts by Membrane Filtration,
W83-03762 5A

MEMBRANE PROCESSES
Industrial Water Reuse with Coupled-Transport Membranes,
W83-03604 5D

Modern Treatment in the Middle East.
W83-03764 5F

MEMBRANES
Industrial Water Reuse with Coupled-Transport Membranes,
W83-03604 5D

Novel Composite Membranes,
W83-03678 3A

Stream-Water Storage in the Ocean Using an Impermeable Membrane,
W83-03772 3B

METAL-FINISHING WASTES
Economical Water Use and Recovery of Valuable Materials by Means of Ion Exchangers in the Surface Finishing Industry (Wirtschaftliche Wasserverwendung Und Wertstoffruckgewinnung Durch Ionenaustauscher In Der Oberflachenveredelnden Industrie),
W83-03521 3E

Industrial Water Reuse with Coupled-Transport Membranes,
W83-03604 5D

METALS
Variables Affecting Metal Removal from Sludge,
W83-03581 5E

Silica in Lakes: Nutrient Competition, Equilibrium Reactions in Sediment Pore Waters, and Role in Metal Cycling,
W83-03699 2H

Metal Surveys in South African Estuaries VI. Sundays River,
W83-03739 5B

Cu, Cd and Zn in Blanca Bay Surface Sediments, Argentina,
W83-03802 5B

Removal of Nitrilotriacetic Acid During Primary Sedimentation and Its Effect on Metal Removal,
W83-03813 5D

METHANE
Seasonal Losses of N sub 2, H sub 2S and CH sub 4 from Sediments to the Atmosphere from Wetlands in the Arrowwood National Wildlife Refuge, North Dakota,
W83-03719 5A

MEXICO
Growth of the Municipal Water System in Ciudad Juarez, Mexico,
W83-03502 5F

MICHIGAN
Interactive Nonstructural Flood-Control Planning,
W83-03831 6F

MICHIGAN MANHOLES
Lake Weir Designed to Resist Ice Damage,
W83-03681 8A

MICROOGANISMS
Biological Problems in Cooling Water Circulation (Biologische Probleme im Kuhlwasserkreislauf),
W83-03528 5B

MICROPOLLUTANTS
Micropollutants Produced by Disinfection of Wastewater Effluents,
W83-03546 5D

Influence of Micropollutants on Vegetation,
W83-03552 5C

Organic Micropollutants in Effluent Recharge to Groundwater,
W83-03553 5B

Nature and Origin of Micropollutants,
W83-03555 5B

MINE DRAINAGE
A Study of Radium-226 and Radon-222 Concentration in Ground Water Near a Phosphate Mining and Manufacturing Facility with Emphasis on the Hydrogeologic Characteristics of the Area,
W83-03714 5B

MINE WASTES
Studies on the Soil Application Treatment of Coking Plant Wastewater (Untersuchungen Zur Bodenbehandlung Von Kokereiabwasser),
W83-03519 5D

MINERALIZATION
Chemistry of the Springs of the Ozark Mountains, Northwestern Arkansas,
W83-03707 2K

MINERALOGY
Mineralogical Model of the Floridan Aquifer in the Southwest Florida Water Management District,
W83-03670 2F

Mineralogy of Sediments in Three Estuaries on Oahu, Hawaii,
W83-03728 2L

MINERALS
The Elimination of Mineral Micropollutants,
W83-03556 5D

MISSISSIPPI
Legal Analysis of the Lee County Water Supply Problem,
W83-03720 6E

Institutional Framework for Conjunction Use of Surface and Groundwater in Tupelo-Lee County, Mississippi: Phase II,
W83-03721 4B

The Feasibility of Engineering-Economic-Management Alternatives for Meeting Water Demands in Tupelo-Lee County, Mississippi,
W83-03722 6D

MISSOURI
Optimum Water Use In Fruit Crop Production,
W83-03669 3F

Diatoms of Lake of the Ozarks, Missouri,
W83-03723 2H

Industrial Wastewater Pretreatment Standards--A Local Approach,
W83-03765 6F

MIST IRRIGATION
Evaporative Cooling by Mist and Sprinkle Irrigation and Conserving Water in Vegetable Irrigation in Arizona,
W83-03729 3F

MIXED LIQUOR SOLIDS
Clarification Failure Control Strategies,
W83-03828 5D

MIXING
Representative Sampling Location Criterion for Rivers,
W83-03740 5A

MODEL STUDIES
Hydrocarbon Removal in a Three-Phase Fluidized Experimental Bed and Modelling of the Process (Epuration Hydrocarbonne en Couche Fluidisee Triphasique Etude Experimentale et Modelisation),
W83-03531 5D

Combined Movement of Groundwaters and Moisture of the Zone of Aeration,
W83-03542 2F

An Improved Understanding of Flow in a Limestone Aquifer Using Field Evidence and Mathematical Models,
W83-03578 2F

Research Needs for Capacity Planning,
W83-03639 6D

A Research Agenda for Municipal Water Demand Forecasting,
W83-03640 6D

Using Water Distribution System Models,
W83-03641 8B

Phase and Compression Behavior in Sedimentation and Thickening of Liquid-Solid Suspensions,
W83-03727 5D

Simplified Mathematical Model of Unsteady Flow in Complex Channel Systems,
W83-03759 8B

Numerical Modeling of Groundwater Flow Processes,
W83-03771 2F

Recent Developments on Stochastic Programming Model for Water Quality Management,
W83-03846 5G

Modelling a River Water Quality System: A Case Study of Tanshui River in Taiwan,
W83-03847 5G

MOLECULAR STRUCTURE
Second Row Molecular Orbital Calculations. 5. A Minimal Basis Indo for Na-Cl,
W83-03613 1B

MOLLISOL
Mineralogy of Sediments in Three Estuaries on Oahu, Hawaii,
W83-03728 2L

MONITORING
Sanitary Monitoring of Seawater in Bathing Areas of France (Surveillance Sanitaire Des Eaux De Baignade En Mer En France),
W83-03515 5G

Alternative Methods of Estimating Pollutant Loads in Flowing Water,
W83-03557 5A

Monitoring Water Quality Parameters from Municipal Water Intakes,
W83-03568 5F

Guidelines for Sampling Ground Water,
W83-03582 5A

River Basin Water Quality Monitoring Network Design,
W83-03593 5A

Representative Sampling Location Criterion for Rivers,
W83-03740 5A

Environmental Quality Standards--New Problems for the Analyst,
W83-03798 5A

MONSOONS
On the Role of Large Scale Energetics in the Onset and Maintenance of Summer Monsoon--II: Moisture Budget,
W83-03786 2B

Hydrometeorological Study of Severe Rainstorms of North Bihar,
W83-03788 2B

A Severe Flood in Luni Basin, Western Rajasthan During July 1979--A Case Study,
W83-03808 2E

MONTANA
A Preliminary Investigation Into the Use of Crayfish as a Sensitive Species to Pollutants in the Clark Fork River Near Missoula, MT,
W83-03617 5B

Salt Status of Glacial Till Soils of North-Central Montana as Affected by the Crop-Fallow System of Dryland Farming,
W83-03769 2G

MULTISTAGE FLASH DISTILLATION
RO vs. MSF for High-Capacity Seawater Desalination Plants,
W83-03622 3A

NATIVE HAWAIIAN WATER RIGHTS
Water Rights, Water Regulation, and the 'Taking Issue' in Hawaii,
W83-03779 6E

NATURAL GAS
Natural Gas Proves to be Economical for Pumping Water,
W83-03715 8C

NATURAL RESOURCES
An Institutional Perspective on the Use of Natural Resources and the Irrigation and Nitrate Contamination Problem,
W83-03587 6B

NEMATOCIDES
1,2-Dibromo-3-Chloropropane Residues in Water in South Carolina, 1970-80,
W83-03744 5B

NETHERLANDS
Measuring the Hydraulic Conductivity of Soil Horizons With Continuous Macropores,
W83-03754 2G

NEUTRALIZATION
Caco3 Neutralization of Acidified Surface Waters,
W83-03834 5G

NEVADA
Relationships Among Precipitation, Snowmelt, Subsurface Flow, Groundwater Recharge, and Streamflow Generation in the Clear Creek Watershed, Eastern Sierra Nevada,
W83-03822 2A

NEW MEXICO
Water-Use Production Functions of Selected Agronomic Crops in Northwestern New Mexico, Phase II,
W83-03560 2D

NEW YORK
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

An Investigation of the Chemistry of Degradation of Pesticides and Other Serious Organic Contaminants in Drinking Water for Application to Domestic and Community Water Supplies,
W83-03725 5F

Effect of Simulated Acid Precipitation on Algal Fixation of Nitrogen and Carbon Dioxide in Forest Soils,
W83-03797 5C

2,3,7,8-Tetrachlorodibenzo-p-Dioxin in Sediment Samples From Love Canal Storm Sewers and Creeks,
W83-03814 5A

Caco3 Neutralization of Acidified Surface Waters,
W83-03834 5G

NEW ZEALAND
Discussion: Flow Resistance in Coarse Gravel Bed Rivers,
W83-03644 8B

Select Hardy Pasture for Drought Surival.
W83-03789 3F

Deep Wells Don't Run Dry,
W83-03810 3B

Irrigation Funding Now More Rational,
W83-03811 6F

NITRATES
Evolution of Nitrate Concentrations in Groundwater in the Middle Vaud Region (Switzerland) (Evolution Des Concentrations en Nitrates Des Eaux Souterraines Du Moyen-Pays Vaudois),
W83-03508 5B

An Institutional Perspective on the Use of Natural Resources and the Irrigation and Nitrate Contamination Problem,
W83-03587 6B

The Nitrogen Balance of Vegetable Crops Irrigated with Untreated Effluent,
W83-03745 5B

NITRILOTRIACETIC ACID
Removal of Nitrilotriacetic Acid During Primary Sedimentation and Its Effect on Metal Removal,
W83-03813 5D

NITRITE
Effects on Channel Catfish of High Nitrite Concentrations That Occur in Fish Ponds,
W83-03698 5C

NITRITES
Toxic Effects of Nitrite on Channel Catfish,
W83-03709 5C

NITROGEN
Water pollution Due to Industrial Trout Production in Fish Farms (Gewasserbelastung Durch Industriemassige Forellenproduktion in Rinnenanlagen),
W83-03520 5B

The Effects of Forest Harvest on Water Quality and Aquatic Life (Phase I),
W83-03686 4D

Significance of Floodplain Sediments in Nutrient Exchange Between a Stream and its Floodplain,
W83-03724 2H

NITROGEN FIXATION
Nitrogen Fixation and Denitrification in the Pamlico River, North Carolina,
W83-03712 5B

Effect of Simulated Acid Precipitation on Algal Fixation of Nitrogen and Carbon Dioxide in Forest Soils,
W83-03797 5C

Effect of Copper on Nitrogen Fixation and Growth of Blue-Green Algae in Natural Plankton Associations,
W83-03837 5F

NITROGEN REMOVAL
Discussion of: Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds and Nitrogen Dynamics in Waste Stabilization Ponds,
W83-03573 5D

Discussion of: Industrial Wastes as Carbon Sources in Biological Denitrification,
W83-03576 5D

Compact Nitrogen Removal Options for Lake Como,
W83-03793 5D

NITROSAMINES
Elimination of Organic Micropollutants,
W83-03547 5D

NONPOINT POLLUTION SOURCES
Administrative Coordination in the Implementation of Agricultural Nonpoint Pollution Controls,
W83-03559 6E

An Institutional Perspective on the Use of Natural Resources and the Irrigation and Nitrate Contamination Problem,
W83-03587 6B

Impact of Snowmelt-Runoff from Agricultural Watersheds on Dissolved Oxygen,
W83-03636 5B

NONSTRUCTURAL ALTERNATIVES
State Options for Nonstructural Flood Risk Management,
W83-03702 6F

Interactive Nonstructural Flood-Control Planning,
W83-03831 6F

NONUNIFORM FLOW
Discussion: Minimum Specific Energy in Compound Open Channel,
W83-03653 8B

NORTH CAROLINA
Factors Regulating Nuisance Blue-Green Algal Bloom Potentials in the Lower Neuse River, N.C.,
W83-03566 5C

The Freshwater Asian Clam (Corbicula Fluminea) as a Factor Affecting Nutrient Cycling in the Chowan River, N.C.,
W83-03588 5B

Sources and Fates of Sedimentary Organic Matter in the White Oak and Neuse River Estuaries,
W83-03590 5B

Variations in Monthly Precipitation Over North Carolina,
W83-03598 7C

Geophysical Mapping Techniques for Groundwater Availability, Central Piedmont Province, North Carolina,
W83-03612 3B

Hydrilla Management in North Carolina.
W83-03616 4A

Biogeochemistry of the Sediments of the Pamlico and Neuse River Estuaries, North Carolina,
W83-03620 2L

Nutrient and Multi-Species Criteria Standard for the Chowan River, North Carolina,
W83-03623 5C

State Options for Nonstructural Flood Risk Management,
W83-03702 6F

Kinetics of Phosphorus Uptake in the Chowan River, North Carolina,
W83-03711 5B

Nitrogen Fixation and Denitrification in the Pamlico River, North Carolina,
W83-03712 5B

The Effects of Bottom Water Anoxia on Benthnic Nutrient Flux Rates in the Pamlico River,
W83-03713 5C

A Study of Radium-226 and Radon-222 Concentration in Ground Water Near a Phosphate Mining and Manufacturing Facility with Emphasis on the Hydrogeologic Characteristics of the Area,
W83-03714 5B

Significance of Floodplain Sediments in Nutrient Exchange Between a Stream and its Floodplain,
W83-03724 2H

Ground Water Yields and Availability in Fractured Crystalline Rocks, Wake County, North Carolina,
W83-03733 2F

Coastal Pollution from Septic Tank Drainfields,
W83-03836 5B

NORTH DAKOTA
Fate of Herbicides in Groundwater and Surface Runoff and Their Biotic Effects on Prairie Potholes,
W83-03682 5B

Seasonal Losses of N sub 2, H sub 2S and CH sub 4 from Sediments to the Atmosphere from Wetlands in the Arrowwood National Wildlife Refuge, North Dakota,
W83-03719 5A

Effect of Seepage from Unlined Municipal Waste Stabilization Lagoons on Chemical Quality of Groundwater in Shallow Aquifers,
W83-03731 5B

NOVA SCOTIA
Alternative Wastewater Management Strategies for Rural and Urban-Fringe Communities,
W83-03823 5D

NUISANCE ALGAE
Factors Regulating Nuisance Blue-Green Algal Bloom Potentials in the Lower Neuse River, N.C.,
W83-03566 5C

Integration of Management Methods with the Life Cycle and Ecology of the Filamentous Alga, Pithophora,
W83-03680 4A

NUTRIENT REQUIREMENTS
Nutrient and Multi-Species Criteria Standard for the Chowan River, North Carolina,
W83-03623 5C

NUTRIENTS
Factors Regulating Nuisance Blue-Green Algal Bloom Potentials in the Lower Neuse River, N.C.,
W83-03566 5C

Biogeochemistry of the Sediments of the Pamlico and Neuse River Estuaries, North Carolina,
W83-03620 2L

Nutrient and Multi-Species Criteria Standard for the Chowan River, North Carolina,
W83-03623 5C

Silica in Lakes: Nutrient Competition, Equilibrium Reactions in Sediment Pore Waters, and Role in Metal Cycling,
W83-03699 2H

Factors Controlling Phytoplankton in Lake Vanda (77 Degrees S),
W83-03838 2H

OHIO
Monitoring Water Quality Parameters from Municipal V/ater Intakes,
W83-03568 5F

OHIO RIVER
Macroinvertebrate Colonization of Multiplate Samplers in the Ohio River: The Effect of Dams,
W83-03824 6G

OKLAHOMA
Impact of Artificial Recharge on Groundwater Quality of Gypsum Aquifer in Harmon County, Oklahoma,
W83-03607 5B

ON-SITE DATA COLLECTION
Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

ONTARIO
Assessment of Heavy Metals and PCBs at Sludge Application Sites,
W83-03633 5E

OPEN CHANNEL FLOW
Hydraulics of Solving Unsteady Debris Flows,
W83-03608 8B

Discussion: Minimum Specific Energy in Compound Open Channel,
W83-03653 8B

OPTIMIZATION
A River Basin Network Model for Conjunctive Use of Surface and Groundwater: Program CONSIM,
W83-03596 6A

OREGON
Water Rights Transfers: A Legal, Economic, and Informational Analysis of Water in Oregon,
W83-03594 6E

Perched Water Tables on Hillsides in Western Oregon: II. Preferential Downslope Movement of Water and Anions,
W83-03751 2G

Perched Water Tables on Hillsides in Western Oregon: I. Some Factors Affecting Their Development and Longevity,
W83-03768 2G

ORGANIC CARBON
Trophic Energetics in Arctic Freshwater Ecosystems,
W83-03621 2L

ORGANIC COMPOUNDS
Elimination of Organic Micropollutants,
W83-03547 5D

Methodology for Determining the Presence and Origin of Organic Micropollutants,
W83-03548 5F

Biological Treatability of Specific Organic Compounds Found in Chemical Industry Wastewaters,
W83-03550 5D

Atmospheric Release of Chlorinated Organic Compounds from the Activated Sludge Process,
W83-03583 5D

The Reactions of Chlorine Disinfectant With Organics Adsorbed on Granular Activated Carbon,
W83-03624 5F

Removal Mechanisms for Toxic Priority Pollutants,
W83-03647 5D

Levels of Nonpolar Organic Compounds in the Columbia Generating Station Cooling Pond,
W83-03717 5C

Isolation, Identification, and Determination of Polycyclic Aromatic Hydrocarbons in Sewage,
W83-03794 5A

Sources of Trihalomethanes and Other C1 and C2 Halo-Organics in Potable Water,
W83-03799 5F

2,3,7,8-Tetrachlorodibenzo-p-Dioxin in Sediment Samples From Love Canal Storm Sewers and Creeks,
W83-03814 5A

Total Organic Halogen (TOX) Concentrations in the West Lafayette Wastewater Treatment Plant Effluent and the Wabash River,
W83-03819 5E

ORGANIC MATTER
Sources and Fates of Sedimentary Organic Matter in the White Oak and Neuse River Estuaries,
W83-03590 5B

ORGANOTIN COMPOUNDS
The Biodegradation of BIS (Tributyltin) Oxide (TBTO) by Bilogical Sewage Treatment (Der Biologische Abbau Von Tributylzinnoxid (TBTO) in Einer Belebtschlammanlage),
W83-03506 5D

ORTHOPHOSPHATES
The Freshwater Asian Clam (Corbicula Fluminea) as a Factor Affecting Nutrient Cycling in the Chowan River, N.C.,
W83-03588 5B

OUTFALL
Physico-Chemical Speciation of Selected Metals in the Treated Effluent of a Lead-Acid Battery Manufacturer and in the Receiving River,
W83-03544 5B

OXIDATION LAGOONS
The Use of Field Crop Residues for Sand Filter Modification of Small Community Wastewater Stabilization Ponds to Meet Secondary Treatment Requirements and Recovery of Plant Nutrient Resources,
W83-03665 5D

OXISOL
Mineralogy of Sediments in Three Estuaries on Oahu, Hawaii,
W83-03728 2L

OXYGEN DEPLETION
The Effects of Bottom Water Anoxia on Benthnic Nutrient Flux Rates in the Pamlico River,
W83-03713 5C

OXYGEN UPTAKE
Measurement and Validity of Oxygen Uptake as an Activated Sludge Process Control Parameter,
W83-03569 5D

OXYGENATION
An Innovative Approach of Operating Rotating Biological Contactor Using Pure Oxygen,
W83-03666 5D

PACKED BED
Preliminary Evaluation of the Pretreatment of Fuel Alcohol Fermentation Stillage Through an Anaerobic Filter,
W83-03664 5D

PARAMETRIC HYDROLOGY
A Parametric Model for Peak Flow Prediction in Ungaged Ephemeral Watersheds,
W83-03778 2A

PARTICULATE MATTER
Solubilization Rate of Atmospheric Particulate Matter and Impact on Water Quality,
W83-03677 5B

PASTURES
Select Hardy Pasture for Drought Surival.
W83-03789 3F

PATH OF POLLUTANTS
Organic Micropollutants in Effluent Recharge to Groundwater,
W83-03553 5B

Movement of Salt and Hazardous Contaminants in Groundwater Systems,
W83-03619 5B

A Finite Element Model to Predict the Flow of Underground Contaminants Due to Leakage of Chemical and/or Radioactive Material From a Buried Containment,
W83-03672 5B

Movement of Bacteria Through Macropores to Ground Water,
W83-03705 5B

Salt Transport in the Lower South Platte River,
W83-03718 5B

Heavy Metal Distribution in Sediments from the Gulf of Catania (Italy),
W83-03803 5B

PEAK DEMAND
Discussion: Residential Water Conservation,
W83-03658 3D

PEAK FLOW
Regional Flood Frequency Analysis for Alaska,
W83-03611 2E

PERCHED WATER TABLE
Perched Water Tables on Hillsides in Western Oregon: II. Preferential Downslope Movement of Water and Anions,
W83-03751 2G

Perched Water Tables on Hillsides in Western Oregon: I. Some Factors Affecting Their Development and Longevity,
W83-03768 2G

PERIPHYTON
Fate of Herbicides in Groundwater and Surface Runoff and Their Biotic Effects on Prairie Potholes,
W83-03682 5B

PERMEABILITY
Perched Water Tables on Hillsides in Western Oregon: II. Preferential Downslope Movement of Water and Anions,
W83-03751 2G

PERMEABILITY COEFFICIENT
Perched Water Tables on Hillsides in Western Oregon: I. Some Factors Affecting Their Development and Longevity,
W83-03768 2G

A Permeameter Which Eliminates Boundary Flow Errors in Saturated Hydraulic Conductivity Measurements,
W83-03770 7B

Field Vs. Laboratory Determined Hydraulic Conductivities of Some Slowly Permeable Horizons,
W83-03781 2G

PESTICIDE RESIDUES
Factors Influencing Dieldrin and DDT Residues in Carp from the Des Moines River, Iowa, 1977-80,
W83-03743 5B

1,2-Dibromo-3-Chloropropane Residues in Water in South Carolina, 1970-80,
W83-03744 5B

PESTICIDES
An Investigation of the Chemistry of Degradation of Pesticides and Other Serious Organic Contaminants in Drinking Water for Application to Domestic and Community Water Supplies,
W83-03725 5F

PHILIPPINES
The Comprehensive Water Quality Management Program for the Laguna De Bay in the Philippines,
W83-03843 5G

PHOSPHATES
Removal of Phosphates,
W83-03791 5D

PHOSPHOROUS REMOVAL
Removal of Phosphates,
W83-03791 5D

PHOSPHORUS
Water pollution Due to Industrial Trout Production in Fish Farms (Gewasserbelastung Durch Industriemassige Forellenproduktion in Rinnenanlagen),
W83-03520 5B

The Effects of Forest Harvest on Water Quality and Aquatic Life (Phase I),
W83-03686 4D

Kinetics of Phosphorus Uptake in the Chowan River, North Carolina,
W83-03711 5B

Significance of Floodplain Sediments in Nutrient Exchange Between a Stream and its Floodplain,
W83-03724 2H

Mathematical Model for Management of Water Quality in Rivers: Application to the Yamaska River (Modele Mathematique De Gestion De La Qualite De L'Eau En Riviere: Application a La Riviere Yamaska),
W83-03839 5G

Agriculture and Water Quality in the Canadian Great Lakes Basin: III. Phosphorus,
W83-03841 5B

PHOTOSYNTHESIS
Factors Controlling Phytoplankton in Lake Vanda (77 Degrees S),
W83-03838 2H

PHYTOPLANKTON
Nutrient and Multi-Species Criteria Standard for the Chowan River, North Carolina,
W83-03623 5C

Kinetics of Phosphorus Uptake in the Chowan River, North Carolina,
W83-03711 5B

Factors Controlling Phytoplankton in Lake Vanda (77 Degrees S),
W83-03838 2H

PIEZOMETERS
Discussion: Long-Term Performance of Embankment Dam Instrumentation,
W83-03642 8G

Discussion: Piezometers in Earth Dam Impervious Sections,
W83-03643 8G

PIPES
Using Water Distribution System Models,
W83-03641 8B

The Interior Surface of Galvanized Steel Pipe: A Potential Factor in Corrosion Resistance,
W83-03650 8G

PITHOPHORA
Integration of Management Methods with the Life Cycle and Ecology of the Filamentous Alga, Pithophora,
W83-03680 4A

PLANNING
Results of Lake Cleanup in the Order-Havel Catchment Areas (Ergebnisse Der Seesanierung Aus Dem Einzugsgebiet Der Wwd Order-Havel),
W83-03516 5G

Technology Transfer Program: Urban Stormwater Management Implementation in Iowa,
W83-03696 4A

State Options for Nonstructural Flood Risk Management,
W83-03702 6F

Strategies for Water Quality Management in the Chao Phraya River in Thailand,
W83-03845 5G

PLANT GROWTH
Growth, Development, and Root Quality of Sweet Potato as Influenced by Soil Warming,
W83-03615 3C

The Effect of Excess and Limited Soil Moisture on Nitrogen Fixation of Several Leguminous Crops,
W83-03687 2I

PLANT POPULATIONS
Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

PLASTIC INDUSTRY
Plastic Pellets on Spain's 'Costa Del Sol' Beaches,
W83-03785 5B

POLICY MAKING
Making Waves: Public Participation in State Water Planning,
W83-03614 6F

Economic Research Needs Relevant to Improved Drinking Water Quality,
W83-03637 6B

POLLUTANT IDENTIFICATION
Methodology for Determining the Presence and Origin of Organic Micropollutants,
W83-03548 5F

Methodology of Research Concerning Micropollutants: Biological Tests,
W83-03554 5A

Development of a Chemical Analysis for Ultratrace Arsenic in Water,
W83-03567 5A

New Correction Procedures for Chromate Interference in the DPD Method for Residual Free and Combined Chlorine in Water,
W83-03579 5A

Guidelines for Sampling Ground Water,
W83-03582 5A

Investigation of Polycyclic Aromatic Hydrocarbons in Water Systems,
W83-03591 5A

Nitrogen Fixation and Denitrification in the Pamlico River, North Carolina,
W83-03712 5B

Seasonal Losses of N sub 2, H sub 2S and CH sub 4 from Sediments to the Atmosphere from Wetlands in the Arrowwood National Wildlife Refuge, North Dakota,
W83-03719 5A

Sampling and Analysis of Industrial Benthic Polynuclear Aromatic Hydrocarbons in Industrialized Urban Watersheds,
W83-03726 5A

Metal Surveys in South African Estuaries VI. Sundays River,
W83-03739 5B

The Suitability of M-Endo-LES Agar for Total Coliform Counts by Membrane Filtration,
W83-03762 5A

Isolation, Identification, and Determination of Polycyclic Aromatic Hydrocarbons in Sewage,
W83-03794 5A

Chemical Composition of Rain Water Over Lucknow in 1980,
W83-03809 2K

POLLUTION LOAD
Alternative Methods of Estimating Pollutant Loads in Flowing Water,
W83-03557 5A

Pollutant Loading Model for Highway Runoff,
W83-03829 5B

Mathematical Model for Management of Water Quality in Rivers: Application to the Yamaska River (Modele Mathematique De Gestion De La Qualite De L'Eau En Riviere: Application a La Riviere Yamaska),
W83-03839 5G

POLYCHLORINATED BIPHENYLS
Assessment of Heavy Metals and PCBs at Sludge Application Sites,
W83-03633 5E

POLYELECTROLYTES
Effect of Polyelectrolytes on Biofilm Growth,
W83-03826 5D

POLYMERS
Effect of Polyelectrolytes on Biofilm Growth,
W83-03826 5D

PONDS
A Dynamic Model of the High-Rate Algal-Bacterial Wastewater Treatment Pond,
W83-03534 5D

POPULATION DYNAMICS
Predicting Future Water Demand,
W83-03835 6D

PORES
Perched Water Tables on Hillsides in Western Oregon: II. Preferential Downslope Movement of Water and Anions,
W83-03751 2G

POTASSIUM CHLORIDE
Hydrodynamic Dispersion Involving Cationic Adsorption During Unsaturated, Transient Water Flow in Soil,
W83-03749 2G

POTHOLE
Fate of Herbicides in Groundwater and Surface Runoff and Their Biotic Effects on Prairie Potholes,
W83-03682 5B

POWDERED ACTIVATED CARBON
A Systematic Study to Reduce Trihalomethane Precursors in Little Rock Drinking Water by Combined Alum Coagulation/Powdered Activated Carbon Treatment,
W83-03683 5F

POWERPLANTS
Levels of Nonpolar Organic Compounds in the Columbia Generating Station Cooling Pond,
W83-03717 5C

Management Model for Power Production From a Geothermal Field: 1. Hot Water Reservoir and Power Plant Model,
W83-03761 8A

PRECIPITATION
Hydrogeochemical Investigations with Regard to the Origin of Heavy Metals in Groundwater (Hydrogeochemische Untersuchungen Zur Herkunft Von Schwermetallen Im Grundwasser),
W83-03511 2K

Variations in Monthly Precipitation Over North Carolina,
W83-03598 7C

Water Balance of the Pearl Harbor-Honolulu Basin, Hawaii, 1946-1975,
W83-03673 4B

Relationships Among Precipitation, Snowmelt, Subsurface Flow, Groundwater Recharge, and Streamflow Generation in the Clear Creek Watershed, Eastern Sierra Nevada,
W83-03822 2A

PREDICTING
Electromagnetic Determination of Soil Water Content Using TDR: I. Applications to Wetting Fronts and Steep Gradients,
W83-03766 7B

PRESSURE-MEASURING INSTRUMENTS
Discussion: Long-Term Performance of Embankment Dam Instrumentation,
W83-03642 8G

Discussion: Piezometers in Earth Dam Impervious Sections,
W83-03643 8G

PRETREATMENT OF WASTEWATER
Industrial Wastewater Pretreatment Standards--A Local Approach,
W83-03765 6F

PRICES
Efficient Pricing and Financing of Urban Water: The Role of Development Charges,
W83-03689 6C

PRICING
Water Pricing Research Needs,
W83-03649 6C

PRIMARY PRODUCTIVITY
Trophic Energetics in Arctic Freshwater Ecosystems,
W83-03621 2L

Hydrochemical Methods of Investigating Production and Destruction Processes in Natural Waters,
W83-03756 2H

PRIORITY POLLUTANTS
Removal Mechanisms for Toxic Priority Pollutants,
W83-03647 5D

PROTECTION
Source Protection - An Ounce of Prevention,
W83-03627 5G

PUBLIC HEALTH
Concentration of Heavy Metals in Fishes from the River Danube (Schwermetallgehalt von Fischen aus der Donau),
W83-03504 5C

Economic Research Needs Relevant to Improved Drinking Water Quality,
W83-03637 6B

PUBLIC PARTICIPATION
Making Waves: Public Participation in State Water Planning,
W83-03614 6F

PUBLIC POLICY
State Options for Nonstructural Flood Risk Management,
W83-03702 6F

PULP AND PAPER INDUSTRY
Enzymatic Pretreatment of Pulp Mill Effluents Prior to Decolorization by Lime Precipitation,
W83-03603 5D

PUMPS
Preferred Solutions and Development Trends for Wastewater Conveyance in Drainage Networks (Vorzugslosungen Und Entwicklungstendenzen Der Abwasserforderung in Entwasserungsnetzen),
W83-03517 5D

Natural Gas Proves to be Economical for Pumping Water,
W83-03715 8C

Geometric Changes Bring Lobe Pumps into Sewage Sludge Markets.
W83-03742 8C

PYRITE
Evaluation of Acid-Mine-Water Generation and Acid-Mine-Drainage Potential of Coal and Coal-Associated Rocks,
W83-03820 5B

QUEBEC
Mathematical Model for Management of Water Quality in Rivers: Application to the Yamaska

River (Modele Mathematique De Gestion De La Qualite De L'Eau En Riviere: Application a La Riviere Yamaska),
W83-03839 5G

RADIOACTIVE DATING
Sources and Fates of Sedimentary Organic Matter in the White Oak and Neuse River Estuaries,
W83-03590 5B

RADIOACTIVITY
Removal of Radon from Water Using Granular Activated Carbon Adsorption,
W83-03564 5F

A Study of Radium-226 and Radon-222 Concentration in Ground Water Near a Phosphate Mining and Manufacturing Facility with Emphasis on the Hydrogeologic Characteristics of the Area,
W83-03714 5B

RADIOISOTOPES
Factors Affecting the Soluble-Suspended Distribution of Strontium-90 and Cesium-137 in Dardanelle Reservoir, Arkansas,
W83-03795 5B

RADON
Removal of Radon from Water Using Granular Activated Carbon Adsorption,
W83-03564 5F

RADON-222
A Study of Radium-226 and Radon-222 Concentration in Ground Water Near a Phosphate Mining and Manufacturing Facility with Emphasis on the Hydrogeologic Characteristics of the Area,
W83-03714 5B

RAIN
Chemical Composition of Rain Water Over Lucknow in 1980,
W83-03809 2K

RAIN GAGES
Automatic Determination of Snow Cover (Schneedecke Automatisch Erfasst),
W83-03529 7B

A Signal Recording and Printing System for Telemetering Raingauges,
W83-03801 7B

RAINFALL
Acid Rain: Sources and Effects in Connecticut Report of the Acid Rain Task Force,
W83-03561 2K

RAINFALL DISTRIBUTION
Variations in Monthly Precipitation Over North Carolina,
W83-03598 7C

An Analysis of Mauritian Winter Rainfall,
W83-03787 2B

Probabiliity Analysis of Short Period Rainfall in Dry Farming Tract in India,
W83-03800 2B

A Severe Flood in Luni Basin, Western Rajasthan During July 1979--A Case Study,
W83-03808 2E

RAINFALL-RUNOFF RELATIONSHIPS
Animal Feedlot Runoff in the Piedmont,
W83-03775 5B

Occurrence Probabilities of Antecedent Moisture Condition Classes in Indiana,
W83-03818 2A

RAINSTORMS
Hydrometeorological Study of Severe Rainstorms of North Bihar,
W83-03788 2B

RECHARGE
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

RECLAIMED WATER
Total Water Management--The Denver Story,
W83-03746 5D

RECREATION
Displacement of Recreational Users Between the Lower St. Croix and Upper Mississippi Rivers,
W83-03842 6D

RECYCLING
Magnesium Recycling by Carbonation and Centrifugation of High-Lime Wastewater Sludge,
W83-03660 5E

REGIONAL DEVELOPMENT
Inquiry into Tax gains for Members of Partnerships (Steuerliche Gewinnermittlung Bei Partnerwerken),
W83-03530 6C

Development of a Regional Sludge Dewatering Facility Using Pressure Filters,
W83-03661 5E

Development of Regional Wetland Restoration Goals: Coastal Wetlands,
W83-03691 6G

Restoration Techniques, Research, and Monitoring: Vegetation,
W83-03694 2L

Towards an Overall Strategy in Designing Wetland Restorations,
W83-03695 4D

REGRESSION ANALYSIS
Monitoring Water Quality Parameters from Municipal Water Intakes,
W83-03568 5F

REHABILITATION
Building Sewer Renovation--A Key to Successful I/I Control,
W83-03747 5D

REMOTE SENSING
Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

RESEARCH NEEDS
Analysis of Critical Water Problems in the Northeastern United States to Determine Essential Research Requirements,
W83-03592 6B

Evaluation of Alternative Procedures for Review of Water Resources Research Proposals,
W83-03600 9D

River Management Research Needs,
W83-03601 6B

RESEARCH PRIORITIES
Analysis of Critical Water Problems in the Northeastern United States to Determine Essential Research Requirements,
W83-03592 6B

Evaluation of Alternative Procedures for Review of Water Resources Research Proposals,
W83-03600 9D

River Management Research Needs,
W83-03601 6B

Research Needs for Capacity Planning,
W83-03639 6D

A Research Agenda for Municipal Water Demand Forecasting,
W83-03640 6D

Research Needs for Water Supply Cost Estimating,
W83-03648 6B

Water Pricing Research Needs,
W83-03649 6C

RESERVOIR CAPACITY
Performance Improvement with Broad-Crowned Spillways (Leistungssteigerung Breitkroniger Uberfalle),
W83-03518 8A

RESERVOIR LININGS
Stream-Water Storage in the Ocean Using an Impermeable Membrane,
W83-03772 3B

RESERVOIR MANAGEMENT
River Management Research Needs,
W83-03601 6B

RESERVOIR OPERATION
A River Basin Network Model for Conjunctive Use of Surface and Groundwater: Program CONSIM,
W83-03596 6A

RESERVOIR SITING
Hydrologic Evaluation of Small Impoundments in Arid and Semiarid Regions,
W83-03667 6G

RESERVOIR STORAGE
Stream-Water Storage in the Ocean Using an Impermeable Membrane,
W83-03772 3B

RESERVOIRS
Reservoir Eutrophication and Management,
W83-03629 5G

Factors Affecting the Soluble-Suspended Distribution of Strontium-90 and Cesium-137 in Dardanelle Reservoir, Arkansas,
W83-03795 5B

RESINS
Bacterial Growth on Ion Exchange Resin - Investigations with a Strong Cationic Exchanger. Part 1: Attachment and Distribution of Bacteria: Operational Possibilities of Supressing Bacterial Growth (Bakterienwachstum Auf Ionenaustauscher-Harz-Untersuchungen an Einem Stark Sauren Kationen-Austauscher. Teil 1: Anhaftung Und Verteilung Der Bakterien; Betriebliche Moglichkeiten Der Wachstums-Unterdruckung),
W83-03507 5F

RESOURCES DEVELOPMENT
Towards an Overall Strategy in Designing Wetland Restorations,
W83-03695 4D

REVERSE OSMOSIS
RO vs. MSF for High-Capacity Seawater Desalination Plants,
W83-03622 3A

Novel Composite Membranes,
W83-03678 3A

REVIEWS
Water Pricing Research Needs,
W83-03649 6C

A Review of the Use of Dyes as Soil Water Tracers,
W83-03736 2G

RIPARIAN RIGHTS
Water Rights, Water Regulation, and the 'Taking Issue' in Hawaii,
W83-03779 6E

RISKS
Managing the Risk and Liability of Toxic Contamination of Water Supply,
W83-03630 6F

RIVER BASINS
A River Basin Network Model for Conjunctive Use of Surface and Groundwater: Program CONSIM,
W83-03596 6A

RIVER FLOW
A Study of Low Flows Using Data From the Severn and Trent Catchments. Part II: Flow Frequency Procedures,
W83-03656 2E

RIVERS
Direct Measurements of Secondary Currents in Natural Meander (Direktmessung Von Sekundarstromungen In Natuerlichen Maandern),
W83-03525 2E

Organically-Bound Copper in Lake and River Waters in Japan,
W83-03536 5B

Displacement of Recreational Users Between the Lower St. Croix and Upper Mississippi Rivers,
W83-03842 6D

Modelling a River Water Quality System: A Case Study of Tanshui River in Taiwan,
W83-03847 5G

ROCKS
Hydrogeochemical Investigations with Regard to the Origin of Heavy Metals in Groundwater (Hydrogeochemische Untersuchungen Zur Herkunft Von Schwermetallen Im Grundwasser),
W83-03511 2K

ROTATING BIOLOGICAL CONTACTOR
An Innovative Approach of Operating Rotating Biological Contactor Using Pure Oxygen,
W83-03666 5D

RUNOFF
Water Balance of the Pearl Harbor-Honolulu Basin, Hawaii, 1946-1975,
W83-03673 4B

RUNOFF RATES
Predicting Infiltration and Surface Runoff from Reconstructed Spoils and Soils,
W83-03610 4C

RURAL DEVELOPMENT
Stated Financing Policies of Government Agencies and the Experience of Rural Water Supply Systems,
W83-03606 6A

SALINE SOILS
A Survey of Soils Irrigated With Arkansas River Water,
W83-03589 3C

SALINE WATER
Salinity and Resource Development Problems in East Kent,
W83-03645 6G

Modern Treatment in the Middle East.
W83-03764 5F

SALINE WATER INTRUSION
Movement of Salt and Hazardous Contaminants in Groundwater Systems,
W83-03619 5B

SALINITY
Salt Transport in the Lower South Platte River,
W83-03718 5B

Salt Status of Glacial Till Soils of North-Central Montana as Affected by the Crop-Fallow System of Dryland Farming,
W83-03769 2G

SALT BALANCE
Salt Transport in the Lower South Platte River,
W83-03718 5B

SALT TOLERANT PLANTS
An Evaluation of Seashore Mallow, Kosteletzkya Virginica (L.) Presl., as a Potential New Crop Which Can Be Grown in Brackish Water,
W83-03618 3C

SAMPLING
Guidelines for Sampling Ground Water,
W83-03582 5A

A Question of Sampling,
W83-03595 7B

Representative Sampling Location Criterion for Rivers,
W83-03740 5A

SAMPLING STATISTICS
Soil Parameters and Sampling Scheme for Characterizing Soil Hydraulic Properties of a Watershed,
W83-03817 2G

SAN FRANCISCO BAY
Currents in South San Francisco Bay,
W83-03690 5B

SAND FILTERS
The Use of Field Crop Residues for Sand Filter Modification of Small Community Wastewater Stabilization Ponds to Meet Secondary Treatment Requirements and Recovery of Plant Nutrient Resources,
W83-03665 5D

SATELLITE TECHNOLOGY
Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

SATURATED FLOW
A Finite Element Model to Predict the Flow of Underground Contaminants Due to Leakage of Chemical and/or Radioactive Material From a Buried Containment,
W83-03672 5B

SCOTLAND
Water Quality in the Firth of Forth,
W83-03784 5D

SEASHORE MALLOW
An Evaluation of Seashore Mallow, Kosteletzkya Virginica (L.) Presl., as a Potential New Crop Which Can Be Grown in Brackish Water,
W83-03618 3C

SEASONAL VARIATION
Pollution of the Mediterranean Coastal Area (La Pollution Du Littoral De La Mediterranee),
W83-03509 5D

An Analysis of Mauritian Winter Rainfall,
W83-03787 2B

SEDIMENT GRADING
Routing Graded Sediments in Streams: Applications,
W83-03832 2J

Routing Graded Sediments in Streams: Formulations,
W83-03833 2J

SEDIMENT TRANSPORT
Discussion: Flow Resistance in Coarse Gravel Bed Rivers,
W83-03644 8B

Routing Graded Sediments in Streams: Applications,
W83-03832 2J

Routing Graded Sediments in Streams: Formulations,
W83-03833 2J

SEDIMENT-WATER INTERFACES
Toxicity of Organolead Compounds: Study of Bacterial Inactivation by Measurement of ATP (Approche De La Toxicite Des Organo Plombs Etude De L'Inactivation Bacterienne Par Mesures D'ATP),
W83-03510 5C

SEDIMENTATION
Engineering Wetlands: Circulation, Sedimentation, and Water Quality,
W83-03693 2L

SEDIMENTS
Sources and Fates of Sedimentary Organic Matter in the White Oak and Neuse River Estuaries,
W83-03590 5B

Biogeochemistry of the Sediments of the Pamlico and Neuse River Estuaries, North Carolina,
W83-03620 2L

The Effects of Forest Harvest on Water Quality and Aquatic Life (Phase I),
W83-03686 4D

Nitrogen Fixation and Denitrification in the Pamlico River, North Carolina,
W83-03712 5B

Significance of Floodplain Sediments in Nutrient Exchange Between a Stream and its Floodplain,
W83-03724 2H

Mineralogy of Sediments in Three Estuaries on Oahu, Hawaii,
W83-03728 2L

Simulation of Nutrient, Microorganism, and Heavy Metal Transport Capacity of Suspended Sediment,
W83-03732 2J

Factors Affecting the Soluble-Suspended Distribution of Strontium-90 and Cesium-137 in Dardanelle Reservoir, Arkansas,
W83-03795 5B

Cu, Cd and Zn in Blanca Bay Surface Sediments, Argentina,
W83-03802 5B

Heavy Metal Distribution in Sediments from the Gulf of Catania (Italy),
W83-03803 5B

Silicones in Chesapeake Bay Sediments,
W83-03804 5B

SEEPAGE
Effect of Seepage from Unlined Municipal Waste Stabilization Lagoons on Chemical Quality of Groundwater in Shallow Aquifers,
W83-03731 5B

SEEPAGE LOSS
Calculations of Seepage Losses of Water Bodies Under the Effect of Infiltration Intakes,
W83-03757 2F

SEISMIC WAVES
Dynamic Analysis of Earth Dams in Three Dimensions,
W83-03651 8D

SEPARATION TECHNIQUES
Batch Flotation Tests: How Useful are They.,
W83-03549 5D

SEPTIC TANK SYSTEMS
Disposal of Household Wastewater in Soils of High Stone Content,
W83-03679 5D

SEPTIC TANKS
Alternative Wastewater Management Strategies for Rural and Urban-Fringe Communities,
W83-03823 5D

Coastal Pollution from Septic Tank Drainfields,
W83-03836 5B

SEWAGE BACTERIA
Toxicity of Organolead Compounds: Study of Bacterial Inactivation by Measurement of ATP (Approche De La Toxicite Des Organo Plombs Etude De L'Inactivation Bacterienne Par Mesures D'ATP),
W83-03510 5C

SEWAGE LAGOONS
The Use of Field Crop Residues for Sand Filter Modification of Small Community Wastewater Stabilization Ponds to Meet Secondary Treatment Requirements and Recovery of Plant Nutrient Resources,
W83-03665 5D

SEWER INFILTRATION
Building Sewer Renovation--A Key to Successful I/I Control,
W83-03747 5D

SEWER SYSTEMS
The Masonry Sewers of Aleppo,
W83-03655 5D

A Study of the Occurrence of Hydrogen Sulfide in Sewers in the Piedmont Area of South Carolina,
W83-03671 8G

Building Sewer Renovation--A Key to Successful I/I Control,
W83-03747 5D

Innovative Approaches to Sewage Collection, Treatment, and Disposal: Practices in Northern Canada,
W83-03840 5D

SHEET FLOW
Separation of Hydraulic Flow Over Topography,
W83-03830 8B

SILICA
Silica in Lakes: Nutrient Competition, Equilibrium Reactions in Sediment Pore Waters, and Role in Metal Cycling,
W83-03699 2H

SILICONES
Silicones in Chesapeake Bay Sediments,
W83-03804 5B

SILTATION
Maintenance Dredging in the Port of Bristol,
W83-03539 8C

SIMULATION
A River Basin Network Model for Conjunctive Use of Surface and Groundwater: Program CONSIM,
W83-03596 6A

SIMULATION MODEL
Simulation of Nutrient, Microorganism, and Heavy Metal Transport Capacity of Suspended Sediment,
W83-03732 2J

SLUDGE
Land Application of Sewage Sludge Landfill Leachate,
W83-03563 5E

Geometric Changes Bring Lobe Pumps into Sewage Sludge Markets.
W83-03742 8C

SLUDGE BLANKET
The Modular Approach to Sewage Treatment.
W83-03741 5D

SLUDGE DIGESTION
Anaerobic Digestion of Waste Activated Sludge,
W83-03827 5D

SLUDGE DISPOSAL
Investigation of the Solidification of Wastewater Concentrates with Inorganic Binding Agents (Untersuchungen Uber die Verfestigung von Abwasserkonzentraten mit Anorganischen Bindemitteln),
W83-03505 5E

Assessment of Heavy Metals and PCBs at Sludge Application Sites,
W83-03633 5E

Development of a Regional Sludge Dewatering Facility Using Pressure Filters,
W83-03661 5E

SLUDGE SOLIDS
Fine-Coal-Aided Centrifugal Dewatering of Waste Activated Sludge,
W83-03659 5E

SLUDGE THICKENING
Phase and Compression Behavior in Sedimentation and Thickening of Liquid-Solid Suspensions,
W83-03727 5D

SMALL WATERSHEDS
The Effects of Forest Harvest on Water Quality and Aquatic Life (Phase I),
W83-03686 4D

SNOW COVER
Automatic Determination of Snow Cover (Schneedecke Automatisch Erfasst),
W83-03529 7B

SNOWMELT
Impact of Snowmelt-Runoff from Agricultural Watersheds on Dissolved Oxygen,
W83-03636 5B

Relationships Among Precipitation, Snowmelt, Subsurface Flow, Groundwater Recharge, and Streamflow Generation in the Clear Creek Watershed, Eastern Sierra Nevada,
W83-03822 2A

SOCIAL ADJUSTMENT
Water Transfers from Agriculture to Industry: Two Utah Examples,
W83-03821 6D

SOCIAL IMPACT
Water Transfers from Agriculture to Industry: Two Utah Examples,
W83-03821 6D

SODIUM CHLORIDE
A Survey of Soils Irrigated With Arkansas River Water,
W83-03589 3C

Second Row Molecular Orbital Calculations. 5. A Minimal Basis Indo for Na-Cl,
W83-03613 1B

SOIL ADSORPTION SYSTEMS
Disposal of Household Wastewater in Soils of High Stone Content,
W83-03679 5D

SOIL BACTERIA
Movement of Bacteria Through Macropores to Ground Water,
W83-03705 5B

SOIL ENGINEERING
Engineering Wetlands: Circulation, Sedimentation, and Water Quality,
W83-03693 2L

SOIL HYDRAULIC INDICES
Soil Parameters and Sampling Scheme for Characterizing Soil Hydraulic Properties of a Watershed,
W83-03817 2G

SOIL MOISTURE
Automatic Determination of Snow Cover (Schneedecke Automatisch Erfasst),
W83-03529 7B

Combined Movement of Groundwaters and Moisture of the Zone of Aeration,
W83-03542 2F

The Effect of Excess and Limited Soil Moisture on Nitrogen Fixation of Several Leguminous Crops,
W83-03687 2I

SOIL PHYSICAL PROPERTIES
A Survey of Soils Irrigated With Arkansas River Water,
W83-03589 3C

SOIL PROPERTIES
Parameters for Describing Soil Detachment Due to Single Waterdrop Impact,
W83-03750 2J

Surface Soil Physical Properties After 36 Years of Cropping to Winter Wheat,
W83-03805 2J

SOIL TEMPERATURE
Growth, Development, and Root Quality of Sweet Potato as Influenced by Soil Warming,
W83-03615 3C

SOIL TREATMENT
Studies on the Soil Application Treatment of Coking Plant Wastewater (Untersuchungen Zur Bodenbehandlung Von Kokereiabwasser),
W83-03519 5D

SOIL WATER
A Review of the Use of Dyes as Soil Water Tracers,
W83-03736 2G

Hydrodynamic Dispersion Involving Cationic Adsorption During Unsaturated, Transient Water Flow in Soil,
W83-03749 2G

Measuring the Hydraulic Conductivity of Soil Horizons With Continuous Macropores,
W83-03754 2G

Heavy Water Tracing of Soil-Water Transfers Under Irrigation,
W83-03755 2G

Electromagnetic Determination of Soil Water Content Using TDR: I. Applications to Wetting Fronts and Steep Gradients,
W83-03766 7B

Trickle Irrigation - Modeling Water and Solutes,
W83-03777 2G

Calculating the Depths of Soil Moisture Control Sections From Laboratory Data,
W83-03780 2G

Field Vs. Laboratory Determined Hydraulic Conductivities of Some Slowly Permeable Horizons,
W83-03781 2G

Constant-Flux Infiltration From a Hemispherical Cavity,
W83-03782 2G

Electromagnetic Determination of Soil Water Content Using TDR: II. Evaluation of Installation and Configuration of Parallel Transmission Lines,
W83-03806 7B

SOIL WATER MOVEMENT
Combined Movement of Groundwaters and Moisture of the Zone of Aeration,
W83-03542 2F

SOIL-WATER-PLANT RELATIONSHIPS
Dredged Sediment for Agriculture: Lake Paradise, Mattoon, Illinois,
W83-03558 3F

Water-Use Production Functions of Selected Agronomic Crops in Northwestern New Mexico, Phase II,
W83-03560 2D

Trickle Irrigation - Modeling Water and Solutes,
W83-03777 2G

SOIL WATER POTENTIAL
Perched Water Tables on Hillsides in Western Oregon: I. Some Factors Affecting Their Development and Longevity,
W83-03768 2G

SOIL WATER TENSIONS
Optimum Water Use In Fruit Crop Production,
W83-03669 3F

SOILS TESTS
Factors Affecting Stress Cell Measurements in Soil,
W83-03657 8D

SOLID WASTES
Investigation of the Solidification of Wastewater Concentrates with Inorganic Binding Agents (Untersuchungen Uber die Verfestigung von Abwasserkonzentraten mit Anorganischen Bindemitteln),
W83-03505 5E

SOLUBILITY
Solubilization Rate of Atmospheric Particulate Matter and Impact on Water Quality,
W83-03677 5B

SOLUTE MOVEMENT
Trickle Irrigation - Modeling Water and Solutes,
W83-03777 2G

SOLUTE TRANSPORT
Hydrodynamic Dispersion Involving Cationic Adsorption During Unsaturated, Transient Water Flow in Soil,
W83-03749 2G

SOURCE OF POLLUTANTS
Atmospheric Release of Chlorinated Organic Compounds from the Activated Sludge Process,
W83-03583 5D

SOUTH AFRICA
Metal Surveys in South African Estuaries V. Kromme and Gamtoos River (St. Francis Bay),
W83-03738 5B

Metal Surveys in South African Estuaries VI. Sundays River,
W83-03739 5B

SOUTH CAROLINA
Effects of Acid Deposition (Rain) on a Piedmont Aquatic Ecosystem: Acid Inputs, Neutralization, and pH Changes,
W83-03700 5C

1,2-Dibromo-3-Chloropropane Residues in Water in South Carolina, 1970-80,
W83-03744 5B

Soybean Responses to Irrigation and Tillage on a Compacted Coastal Plains Soil,
W83-03774 2I

Animal Feedlot Runoff in the Piedmont,
W83-03775 5B

SOUTH CAROLINA PIEDMONT
A Study of the Occurrence of Hydrogen Sulfide in Sewers in the Piedmont Area of South Carolina,
W83-03671 8G

SOYBEANS
Soybean Responses to Irrigation and Tillage on a Compacted Coastal Plains Soil,
W83-03774 2I

SPAIN
Plastic Pellets on Spain's 'Costa Del Sol' Beaches,
W83-03785 5B

SPARTINA
Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

SPECIATION
Physico-Chemical Speciation of Selected Metals in the Treated Effluent of a Lead-Acid Battery Manufacturer and in the Receiving River,
W83-03544 5B

SPECIES DIVERSITY
The Effects of Forest Harvest on Water Quality and Aquatic Life (Phase I),
W83-03686 4D

SPOILS
Predicting Infiltration and Surface Runoff from Reconstructed Spoils and Soils,
W83-03610 4C

SPRINGS
Chemistry of the Springs of the Ozark Mountains, Northwestern Arkansas,
W83-03707 2K

SPRINKLE IRRIGATION
Evaporative Cooling by Mist and Sprinkle Irrigation and Conserving Water in Vegetable Irrigation in Arizona,
W83-03729 3F

SPRINKLER IRRIGATION
A Modified Line Source Sprinkler Technique for Continuous-Variable Leaching Studies,
W83-03767 3F

STABILIZATION LAGOONS
Pollution of the Mediterranean Coastal Area (La Pollution Du Littoral De La Mediterranee),
W83-03509 5D

Effect of Seepage from Unlined Municipal Waste Stabilization Lagoons on Chemical Quality of Groundwater in Shallow Aquifers,
W83-03731 5B

STABILIZATION PONDS
Pollution of the Mediterranean Coastal Area (La Pollution Du Littoral De La Mediterranee),
W83-03509 5D

Discussion of: Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds and Nitrogen Dynamics in Waste Stabilization Ponds,
W83-03573 5D

STANDARDS
Here Comes the Water Bubble--Maybe,
W83-03634 5G

Changing the Clean Water Act: Reflections on the Long-Term.
W83-03635 6E

The Estimation and Application of the Demand for Discharge Within the Context of Water Quality Management Systems,
W83-03701 6F

STATE REGULATION
Legal Analysis of the Lee County Water Supply Problem,
W83-03720 6E

STATISTICAL ANALYSIS
Statistical Analysis of Crop Yield Controlled Line-Source Irrigation,
W83-03753 3F

STORM RUNOFF
Water Quality of Airport Storm Runoff, Phase II,
W83-03688 5B

Pollutant Loading Model for Highway Runoff,
W83-03829 5B

STORM WATER
Technology Transfer Program: Urban Stormwater Management Implementation in Iowa,
W83-03696 4A

STREAM GAGES
River Basin Water Quality Monitoring Network Design,
W83-03593 5A

The Snowy Range Observatory: Climatological and Streamflow Data Report 1982,
W83-03675 7C

STREAM POLLUTION
Alternative Methods of Estimating Pollutant Loads in Flowing Water,
W83-03557 5A

STREAM-WATER STORAGE
Stream-Water Storage in the Ocean Using an Impermeable Membrane,
W83-03772 3B

STREAMFLOW
Path of a Vortex in a Semi-Infinite Region With a Streaming Motion along a Plane Wall Boundary Having a Semicircular Bay or Bulge,
W83-03807 2E

STRESS CELLS
Factors Affecting Stress Cell Measurements in Soil,
W83-03657 8D

STRONGLY IMPLICIT PROCEDURE
Impact of Artificial Recharge on Groundwater Quality of Gypsum Aquifer in Harmon County, Oklahoma,
W83-03607 5B

SUBSIDENCE
Measurement, Prediction, and Hazard Evaluation of Earth Fissuring and Subsidence Due to Ground-Water Overdraft,
W83-03668 2F

SUBSURFACE FLOW
Relationships Among Precipitation, Snowmelt, Subsurface Flow, Groundwater Recharge, and Streamflow Generation in the Clear Creek Watershed, Eastern Sierra Nevada,
W83-03822 2A

SUBSURFACE WATER
Some Current Problems in Investigations of the Interaction of Subsurface and Surface Waters of the USSR,
W83-03734 6D

SULFIDES
Evaluation of Acid-Mine-Water Generation and Acid-Mine-Drainage Potential of Coal and Coal-Associated Rocks,
W83-03820 5B

SURFACE DRAINAGE
Surface Soil Physical Properties After 36 Years of Cropping to Winter Wheat,
W83-03805 2J

SURFACE-GROUNDWATER RELATIONS
Some Current Problems in Investigations of the Interaction of Subsurface and Surface Waters of the USSR,
W83-03734 6D

Relationships Among Precipitation, Snowmelt, Subsurface Flow, Groundwater Recharge, and Streamflow Generation in the Clear Creek Watershed, Eastern Sierra Nevada,
W83-03822 2A

SURFACE RUNOFF
Water Harvesting for Afforestation: III. Dependence of Tree Growth on Amount and Distribution of Precipitation,
W83-03752 3B

Animal Feedlot Runoff in the Piedmont,
W83-03775 5B

SUSPENDED SOLIDS
Filtration of Primary Effluent,
W83-03574 5D

Clarification Failure Control Strategies,
W83-03828 5D

SWAMPS
Significance of Floodplain Sediments in Nutrient Exchange Between a Stream and its Floodplain,
W83-03724 2H

SWIMMING
Sanitary Monitoring of Seawater in Bathing Areas of France (Surveillance Sanitaire Des Eaux De Baignade En Mer En France),
W83-03515 5G

SWITZERLAND
Evolution of Nitrate Concentrations in Groundwater in the Middle Vaud Region (Switzerland) (Evolution Des Concentrations en Nitrates Des Eaux Souterraines Du Moyen-Pays Vaudois),
W83-03508 5B

Automatic Determination of Snow Cover (Schneedecke Automatisch Erfasst),
W83-03529 7B

Inquiry into Tax gains for Members of Partnerships (Steuerliche Gewinnermittlung Bei Partnerwerken),
W83-03530 6C

SYRIA
The Masonry Sewers of Aleppo,
W83-03655 5D

TAIWAN
Modelling a River Water Quality System: A Case Study of Tanshui River in Taiwan,
W83-03847 5G

TAXES
Inquiry into Tax gains for Members of Partnerships (Steuerliche Gewinnermittlung Bei Partnerwerken),
W83-03530 6C

TELEMETRY
A Signal Recording and Printing System for Telemetering Raingauges,
W83-03801 7B

TEMPERATURE DISTRIBUTION
Estimating Mixing in Aquifers by Temperature Distribution,
W83-03605 2F

TESTING PROCEDURES
Tests on Aerators: Conclusions Drawn From 500 Clean Water Tests Conducted in 200 Different Sewage Treatment Plants - I Test Procedure (Essais D'Aerateurs Enseignements Tires De 500 Essais En Eu Clair Effectues Dans 200 Stations D'Epuration Differentes - I Methodologie),
W83-03535 5D

Batch Flotation Tests: How Useful are They.,
W83-03549 5D

Methodology of Research Concerning Micropollutants: Biological Tests,
W83-03554 5A

TEXAS
Groundwater Resources of the Texas Rio Grande Basin,
W83-03503 2F

THAILAND
Strategies for Water Quality Management in the Chao Phraya River in Thailand,
W83-03845 5G

THERMAL POLLUTION
A Method To Compute River Heating - Application to the Management of Thermal Loadings to the Rhine River (Une Methode De Calcul De L'Echauffement Des Rivieres - Application a La Gestion Des Rejets Themiques Au Rhin),
W83-03584 5G

THERMAL WATER
Growth, Development, and Root Quality of Sweet Potato as Influenced by Soil Warming,
W83-03615 3C

THM PRECURSORS
A Systematic Study to Reduce Trihalomethane Precursors in Little Rock Drinking Water by Combined Alum Coagulation/Powdered Activated Carbon Treatment,
W83-03683 5F

THREATENED SPECIES
Population Biology in Small Hawaiian Streams,
W83-03676 6G

TIDAL MARSHES
Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

TIDE EFFECTS
Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

TIDES
Currents in South San Francisco Bay,
W83-03690 5B

TIME-DOMAIN REFLECTOMETRY
Electromagnetic Determination of Soil Water Content Using TDR: I. Applications to Wetting Fronts and Steep Gradients,
W83-03766 7B

TOPOGRAPHY
Separation of Hydraulic Flow Over Topography,
W83-03830 8B

TOTAL ORGANIC HALOGENS
Total Organic Halogen (TOX) Concentrations in the West Lafayette Wastewater Treatment Plant Effluent and the Wabash River,
W83-03819 5E

TOXICITY
Toxicity of Organolead Compounds: Study of Bacterial Inactivation by Measurement of ATP (Approche De La Toxicite Des Organo Plombs Etude De L'Inactivation Bacterienne Par Mesures D'ATP),
W83-03510 5C

Methodology of Research Concerning Micropollutants: Biological Tests,
W83-03554 5A

Toxic Effects of Nitrite on Channel Catfish,
W83-03709 5C

Effect of Copper on Nitrogen Fixation and Growth of Blue-Green Algae in Natural Plankton Associations,
W83-03837 5F

TRACE ELEMENTS
Chemical Composition of Rain Water Over Lucknow in 1980,
W83-03809 2K

TRACE METALS
Metal Surveys in South African Estuaries V. Kromme and Gamtoos River (St. Francis Bay),
W83-03738 5B

TRACERS
A Review of the Use of Dyes as Soil Water Tracers,
W83-03736 2G

TRAINING
Aquaculture Techniques: A Computer Simulation of an Intensive Fish Culture System (Aqua),
W83-03685 8I

TRANSIENT FLOW
Hydrodynamic Dispersion Involving Cationic Adsorption During Unsaturated, Transient Water Flow in Soil,
W83-03749 2G

TRANSMISSIVITY
Impact of Artificial Recharge on Groundwater Quality of Gypsum Aquifer in Harmon County, Oklahoma,
W83-03607 5B

TRANSPIRATION
Water-Use Production Functions of Selected Agronomic Crops in Northwestern New Mexico, Phase II,
W83-03560 2D

TREE GROWTH
Water Harvesting for Afforestation: III. Dependence of Tree Growth on Amount and Distribution of Precipitation,
W83-03752 3B

TRICKLE IRRIGATION
Trickle Irrigation - Modeling Water and Solutes,
W83-03777 2G

TRICKLING FILTERS
Dispersion in the Inclined Plane Model of Trickling Filters,
W83-03537 5D

TRIHALOMETHANES
Survey of Trihalomethane Levels in Rhone-Alps Water Supplies. Estimates on the Formation of Chloroform in Wastewater Treatment Plants and Swimming Pools,
W83-03540 5B

Chloramines - An Answer to the Trihalomethane Problem,
W83-03625 5F

A Systematic Study to Reduce Trihalomethane Precursors in Little Rock Drinking Water by

Combined Alum Coagulation/Powdered Activated Carbon Treatment,
W83-03683 5F

TROPICAL REGIONS
An Analysis of Mauritian Winter Rainfall,
W83-03787 2B

TROUT
Water pollution Due to Industrial Trout Production in Fish Farms (Gewasserbelastung Durch Industriemassige Forellenproduktion in Rinnenanlagen),
W83-03520 5B

TURKEY
Environmental Limiting Factors Affecting the Growth and Spread of Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur Lake (Die Umweltfaktoren, Die Die Verbreitung Und Entwicklung Von Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur-See Begrenzen),
W83-03543 5C

UNDERGROUND STORAGE
Use of Natural Underground Reservoirs for Control of Surface Runoff,
W83-03758 4B

UNGAGED WATERSHEDS
Regional Flood Frequency Analysis for Alaska,
W83-03611 2E

UNITED KINGDOM
Salinity and Resource Development Problems in East Kent,
W83-03645 6G

A Study of Low Flows Using Data From the Severn and Trent Catchments. Part II: Flow Frequency Procedures,
W83-03656 2E

UNSATURATED FLOW
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

UNSTEADY FLOW
Simplified Mathematical Model of Unsteady Flow in Complex Channel Systems,
W83-03759 8B

URBAN AREAS
Predicting Future Water Demand,
W83-03835 6D

URBAN HYDROLOGY
Technology Transfer Program: Urban Stormwater Management Implementation in Iowa,
W83-03696 4A

URBAN PLANNING
Water Conservation in Residential Development: Land-Use Techniques,
W83-03716 3D

URBAN RUNOFF
The Impact of Urbanization on a Flood-Plain Aquifer: Bloomington, Indiana,
W83-03609 5B

URBAN WATER
Efficient Pricing and Financing of Urban Water: The Role of Development Charges,
W83-03689 6C

UREA
Column Design for Recovery of NH3 and CO2 from Wastewater in a Urea Plant,
W83-03748 5D

USER CHARGES
Water Pricing Research Needs,
W83-03649 6C

USSR
Some Current Problems in Investigations of the Interaction of Subsurface and Surface Waters of the USSR,
W83-03734 6D

Hydrochemical Methods of Investigating Production and Destruction Processes in Natural Waters,
W83-03756 2H

Use of Natural Underground Reservoirs for Control of Surface Runoff,
W83-03758 4B

Simplified Mathematical Model of Unsteady Flow in Complex Channel Systems,
W83-03759 8B

Rate of Denitrification in Water Bodies of an Irrigation System and Soil of Rice Fields in the Kara Kalpuk ASSR,
W83-03760 5B

Vertical Distribution of Zooplankton in the Mologa River in Winter,
W83-03815 2H

UTAH
Water Transfers from Agriculture to Industry: Two Utah Examples,
W83-03821 6D

VADOSEWATER
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

VARIABILITY
Variations in Monthly Precipitation Over North Carolina,
W83-03598 7C

VARIAGRAM
Statistical Analysis of Crop Yield Controlled Line-Source Irrigation,
W83-03753 3F

VEGETATION
Influence of Micropollutants on Vegetation,
W83-03552 5C

Restoration Techniques, Research, and Monitoring: Vegetation,
W83-03694 2L

VELOCITY DISTRIBUTION
Discussion: Minimum Specific Energy in Compound Open Channel,
W83-03653 8B

VERMONT
Source Protection - An Ounce of Prevention,
W83-03627 5G

VERTICAL DISTRIBUTION
Vertical Distribution of Zooplankton in the Mologa River in Winter,
W83-03815 2H

VIRUSES
Coastal Pollution from Septic Tank Drainfields,
W83-03836 5B

VOLCANOES
The Fate, Distribution and Limnological Effects of Volcanic Tephra in the St. Joe and Coeur D'Alene River Deltas of Lake Coeur D'Alene, Idaho,
W83-03597 5B

VORTICES
Path of a Vortex in a Semi-Infinite Region With a Streaming Motion along a Plane Wall Boundary Having a Semicircular Bay or Bulge,
W83-03807 2E

WASHINGTON
Pollutant Loading Model for Highway Runoff,
W83-03829 5B

WASTE DUMPS
Landfill Management and Leachate Quality,
W83-03812 5E

WASTE RECOVERY
Economical Water Use and Recovery of Valuable Materials by Means of Ion Exchangers in the Surface Finishing Industry (Wirtschaftliche Wasserverwendung Und Wertstoffruckgewinnung Durch Ionenaustauscher In Der Oberflachenveredelnden Industrie),
W83-03521 3E

WASTERWATER TREATMENT
Tests on Aerators: Conclusions Drawn From 500 Clean Water Tests Conducted in 200 Different Sewage Treatment Plants - I Test Procedure (Essais D'Aerateurs Enseignements Tires De 500 Essais En Eu Clair Effectues Dans 200 Stations D'Epuration Differentes - I Methodologie),
W83-03535 5D

WASTEWATER ANALYSIS
Enterococci and Other Microbial Indicators in Municipal Wastewater Effluents,
W83-03551 5A

Evaluation of a Dissolved Oxygen Field Test Protocol,
W83-03631 7B

Enumeration of Chlorine-Damaged Fecal Coliforms in Wastewater Effluents,
W83-03632 5D

Isolation, Identification, and Determination of Polycyclic Aromatic Hydrocarbons in Sewage,
W83-03794 5A

WASTEWATER ANLYSIS
Sampling and Analysis of Industrial Benthic Polynuclear Aromatic Hydrocarbons in Industrialized Urban Watersheds,
W83-03726 5A

WASTEWATER COLLECTION
Preferred Solutions and Development Trends for Wastewater Conveyance in Drainage Networks (Vorzugslosungen Und Entwicklungstendenzen Der Abwasserforderung in Entwasserungsnetzen),
W83-03517 5D

WASTEWATER DISPOSAL
Land Application of Sewage Sludge Landfill Leachate,
W83-03563 5E

Disposal of Household Wastewater in Soils of High Stone Content,
W83-03679 5D

Innovative Approaches to Sewage Collection, Treatment, and Disposal: Practices in Northern Canada,
W83-03840 5D

WASTEWATER IRRIGATION
Studies on the Soil Application Treatment of Coking Plant Wastewater (Untersuchungen Zur Bodenbehandlung Von Kokereiabwasser),
W83-03519 5D

The Nitrogen Balance of Vegetable Crops Irrigated with Untreated Effluent,
W83-03745 5B

WASTEWATER LAGOONS
Discussion of: Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds and Nitrogen Dynamics in Waste Stabilization Ponds,
W83-03573 5D

WASTEWATER MANAGEMENT
Alternative Wastewater Management Strategies for Rural and Urban-Fringe Communities,
W83-03823 5D

WASTEWATER TREATEMENT
Enzymatic Pretreatment of Pulp Mill Effluents Prior to Decolorization by Lime Precipitation,
W83-03603 5D

WASTEWATER TREATMENT
The Biodegradation of BIS (Tributyltin) Oxide (TBTO) by Bilogical Sewage Treatment (Der Biologische Abbau Von Tributylzinnoxid (TBTO) in Einer Belebtschlammanlage),
W83-03506 5D

Pollution of the Mediterranean Coastal Area (La Pollution Du Littoral De La Mediterranee),
W83-03509 5D

Hydrocarbon Removal in a Three-Phase Fluidized Experimental Bed and Modelling of the Process (Epuration Hydrocarbonne en Couche Fluidisee Triphasique Etude Experimentale et Modelisation),
W83-03531 5D

The Adsorption of Bovine Serum Albumin by Activated Sludge,
W83-03533 5D

A Dynamic Model of the High-Rate Algal-Bacterial Wastewater Treatment Pond,
W83-03534 5D

Dispersion in the Inclined Plane Model of Trickling Filters,
W83-03537 5D

The Biodegradation of N-Methyl-2-Pyrrolidone in Water by Sewage Bacteria,
W83-03538 5D

Innovative Technology Recycles Waste.
W83-03545 5D

Micropollutants Produced by Disinfection of Wastewater Effluents,
W83-03546 5D

Elimination of Organic Micropollutants,
W83-03547 5D

Batch Flotation Tests: How Useful are They.,
W83-03549 5D

Biological Treatability of Specific Organic Compounds Found in Chemical Industry Wastewaters,
W83-03550 5D

Enterococci and Other Microbial Indicators in Municipal Wastewater Effluents,
W83-03551 5A

The Elimination of Mineral Micropollutants,
W83-03556 5D

Measurement and Validity of Oxygen Uptake as an Activated Sludge Process Control Parameter,
W83-03569 5D

Determination of Biomass MLVSS in Pact Sludges,
W83-03570 5D

Use of Hydrocyclones to Treat Seafood-Processing Wastewaters,
W83-03572 5D

Discussion of: Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds and Nitrogen Dynamics in Waste Stabilization Ponds,
W83-03573 5D

Filtration of Primary Effluent,
W83-03574 5D

Treatment of Raw Wastewater Overflows by Dissolved-Air Flotation,
W83-03575 5D

Discussion of: Industrial Wastes as Carbon Sources in Biological Denitrification,
W83-03576 5D

Variables Affecting Metal Removal from Sludge,
W83-03581 5E

Atmospheric Release of Chlorinated Organic Compounds from the Activated Sludge Process,
W83-03583 5D

Industrial Water Reuse with Coupled-Transport Membranes,
W83-03604 5D

Evaluation of a Dissolved Oxygen Field Test Protocol,
W83-03631 7B

Enumeration of Chlorine-Damaged Fecal Coliforms in Wastewater Effluents,
W83-03632 5D

Changing the Clean Water Act: Reflections on the Long-Term.
W83-03635 6E

Removal Mechanisms for Toxic Priority Pollutants,
W83-03647 5D

Preliminary Evaluation of the Pretreatment of Fuel Alcohol Fermentation Stillage Through an Anaerobic Filter,
W83-03664 5D

An Innovative Approach of Operating Rotating Biological Contactor Using Pure Oxygen,
W83-03666 5D

Disposal of Household Wastewater in Soils of High Stone Content,
W83-03679 5D

Biological Treatment of Cyanide in High-Strength Coke-Plant Wastewater,
W83-03697 5D

Waste Water Treatment by Ligand Exchange,
W83-03706 5D

Adaptation of an Activated Sludge Process to the Treatment of Coke-Plant Wastewater Containing High Levels of Cyanide,
W83-03710 5D

An Investigation of the Chemistry of Degradation of Pesticides and Other Serious Organic Contaminants in Drinking Water for Application to Domestic and Community Water Supplies,
W83-03725 5F

Phase and Compression Behavior in Sedimentation and Thickening of Liquid-Solid Suspensions,
W83-03727 5D

Comparative Evaluation of Mathematical Models Used for Calculating Biological Filters,
W83-03735 5D

Harvesting of Algae Grown on Raw Sewage,
W83-03737 5D

The Modular Approach to Sewage Treatment.
W83-03741 5D

Column Design for Recovery of NH3 and CO2 from Wastewater in a Urea Plant,
W83-03748 5D

Sub-Surface Aerator/Mixing Units.
W83-03763 5D

Water Quality in the Firth of Forth,
W83-03784 5D

Removal of Phosphates,
W83-03791 5D

Pilot Plant Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W83-03792 5D

Compact Nitrogen Removal Options for Lake Como,
W83-03793 5D

Removal of Nitrilotriacetic Acid During Primary Sedimentation and Its Effect on Metal Removal,
W83-03813 5D

Total Organic Halogen (TOX) Concentrations in the West Lafayette Wastewater Treatment Plant Effluent and the Wabash River,
W83-03819 5E

Alternative Wastewater Management Strategies for Rural and Urban-Fringe Communities,
W83-03823 5D

Activated Carbon for Treatment of Cadmium Wastewater,
W83-03825 5D

Effect of Polyelectrolytes on Biofilm Growth,
W83-03826 5D

Anaerobic Digestion of Waste Activated Sludge,
W83-03827 5D

Clarification Failure Control Strategies,
W83-03828 5D

Innovative Approaches to Sewage Collection, Treatment, and Disposal: Practices in Northern Canada,
W83-03840 5D

WASTEWATER TREATMENT FACILITIES
Tests on Aerators: Conclusions Drawn From 500 Clean Water Tests Conducted in 200 Different Sewage Treatment Plants - I Test Procedure (Essais D'Aerateurs Enseignements Tires De 500 Essais En Eu Clair Effectues Dans 200 Stations D'Epuration Differentes - I Methodologie),
W83-03535 5D

WATER-AIR INTERFACES
Acid Rain: Sources and Effects in Connecticut Report of the Acid Rain Task Force,
W83-03561 2K

WATER ALLOCATION
Legal Analysis of the Lee County Water Supply Problem,
W83-03720 6E

WATER ANALYSIS
Survey of Trihalomethane Levels in Rhone-Alps Water Supplies. Estimates on the Formation of Chloroform in Wastewater Treatment Plants and Swimming Pools,
W83-03540 5B

New Correction Procedures for Chromate Interference in the DPD Method for Residual Free and Combined Chlorine in Water,
W83-03579 5A

WATER BALANCE
Water Balance of the Pearl Harbor-Honolulu Basin, Hawaii, 1946-1975,
W83-03673 4B

WATER CONSERVATION
Economical Water Use and Recovery of Valuable Materials by Means of Ion Exchangers in the Surface Finishing Industry (Wirtschaftliche Wasserverwendung Und Wertstoffruckgewin-

nung Durch Ionenaustauscher In Der Oberflachenveredelnden Industrie),
W83-03521 3E

Discussion: Residential Water Conservation,
W83-03658 3D

Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

Water Conservation in Residential Development: Land-Use Techniques,
W83-03716 3D

Evaporative Cooling by Mist and Sprinkle Irrigation and Conserving Water in Vegetable Irrigation in Arizona,
W83-03729 3F

WATER CONVEYANCE
The Mid-Term Extension Program for the Bodensee-Wasserversorgung (Der Mittelfristige Ausbau Der Bodensee-Wasserversorgung),
W83-03523 5F

WATER COSTS
Research Needs for Water Supply Cost Estimating,
W83-03648 6B

Water Pricing Research Needs,
W83-03649 6C

Efficient Pricing and Financing of Urban Water: The Role of Development Charges,
W83-03689 6C

WATER CURRENTS
Direct Measurements of Secondary Currents in Natural Meander (Direktmessung Von Sekundarstromungen In Natuerlichen Maandern),
W83-03525 2E

Currents in South San Francisco Bay,
W83-03690 5B

Macroinvertebrate Colonization of Multiplate Samplers in the Ohio River: The Effect of Dams,
W83-03824 6G

WATER DEMAND
Groundwater Resources of the Texas Rio Grande Basin,
W83-03503 2F

Research Needs for Capacity Planning,
W83-03639 6D

A Research Agenda for Municipal Water Demand Forecasting,
W83-03640 6D

Increasing Rockport's Water Supply,
W83-03662 6D

The Feasibility of Engineering-Economic-Management Alternatives for Meeting Water Demands in Tupelo-Lee County, Mississippi,
W83-03722 6D

Predicting Future Water Demand,
W83-03835 6D

WATER DISTRIBUTION
Growth of the Municipal Water System in Ciudad Juarez, Mexico,
W83-03502 5F

WATER HARVESTING
Water Harvesting for Afforestation: III. Dependence of Tree Growth on Amount and Distribution of Precipitation,
W83-03752 3B

WATER LAW
Water Rights Transfers: A Legal, Economic, and Informational Analysis of Water in Oregon,
W83-03594 6E

A Comparative Evaluation of Ground-Water Management Techniques,
W83-03704 4B

Legal Analysis of the Lee County Water Supply Problem,
W83-03720 6E

WATER MANAGEMENT
The Mid-Term Extension Program for the Bodensee-Wasserversorgung (Der Mittelfristige Ausbau Der Bodensee-Wasserversorgung),
W83-03523 5F

How Much Preventive Maintenance is too Much,
W83-03638 5D

Research Needs for Water Supply Cost Estimating,
W83-03648 6B

A Comparative Evaluation of Ground-Water Management Techniques,
W83-03704 4B

Establishing Water Quality Objectives and Emission Targets in Rivers,
W83-03848 5G

WATER MEASUREMENT
River Basin Water Quality Monitoring Network Design,
W83-03593 5A

WATER METERING
The History of Waste Detection in Severn-Trent Water Authority's Derwent Division,
W83-03654 5F

WATER POLLUTION
River Basin Water Quality Monitoring Network Design,
W83-03593 5A

WATER POLLUTION CONTROL
Principles for Transboundary Groundwater Pollution Control,
W83-03501 5G

Biological Problems in Cooling Water Circulation (Biologische Probleme im Kuhlwasserkreislauf),
W83-03528 5B

Administrative Coordination in the Implementation of Agricultural Nonpoint Pollution Controls,
W83-03559 6E

Engineering and Legal Ramifications of Groundwater Contamination - A Case Study,
W83-03626 5G

Managing the Risk and Liability of Toxic Contamination of Water Supply,
W83-03630 6F

Here Comes the Water Bubble--Maybe,
W83-03634 5G

WATER POLLUTION EFFECTS
Concentration of Heavy Metals in Fishes from the River Danube (Schwermetallgehalt von Fischen aus der Donau),
W83-03504 5C

Acidification Effects on Macroinvertebrates and Fathead Minnows (Pimephales Promelas) in Outdoor Experimental Channels,
W83-03532 5C

Environmental Limiting Factors Affecting the Growth and Spread of Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur Lake (Die Umweltfaktoren, Die Die Verbreitung Und Entwicklung Von Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur-See Begrenzen),
W83-03543 5C

Influence of Micropollutants on Vegetation,
W83-03552 5C

Toxic Effects of Nitrite on Channel Catfish,
W83-03709 5C

WATER POLLUTION PREVENTION
Biological Problems in Cooling Water Circulation (Biologische Probleme im Kuhlwasserkreislauf),
W83-03528 5B

WATER POLLUTION SOURCES
Biological Problems in Cooling Water Circulation (Biologische Probleme im Kuhlwasserkreislauf),
W83-03528 5B

Nature and Origin of Micropollutants,
W83-03555 5B

Movement of Salt and Hazardous Contaminants in Groundwater Systems,
W83-03619 5B

Metal Surveys in South African Estuaries V. Kromme and Gamtoos River (St. Francis Bay),
W83-03738 5B

Plastic Pellets on Spain's 'Costa Del Sol' Beaches,
W83-03785 5B

Silicones in Chesapeake Bay Sediments,
W83-03804 5B

Evaluation of Acid-Mine-Water Generation and Acid-Mine-Drainage Potential of Coal and Coal-Associated Rocks,
W83-03820 5B

Pollutant Loading Model for Highway Runoff,
W83-03829 5B

Coastal Pollution from Septic Tank Drainfields,
W83-03836 5B

WATER PRESSURE
Development of Suitable Closure Specifications for Remote Controlled Ball Valves to Limit Water Hammer in Pipelines of the Zweckverband Landeswasserversorgung Stuttgart (Entwicklung Geeigneter Schliessgesetze Zur Druckstossbegranzung Bei Ferngesteuerten Kugelschiebern In Den Fernwasserleitung Des Zweckverbandes Landeswasserversorgung Stuttgart),
W83-03524 8C

Using Water Distribution System Models,
W83-03641 8B

WATER QUALITY
Coliphages and Coliform Bacteriain Running Waters of Different Quality (Coliphagen und Coliforme Bakterien in Fliessgewassern Unterschiedlicher Gute),
W83-03513 5A

Sanitary Monitoring of Seawater in Bathing Areas of France (Surveillance Sanitaire Des Eaux De Baignade En Mer En France),
W83-03515 5G

Monitoring Water Quality Parameters from Municipal Water Intakes,
W83-03568 5F

WATER QUALITY

River Basin Water Quality Monitoring Network Design,
W83-03593 5A

A Preliminary Investigation Into the Use of Crayfish as a Sensitive Species to Pollutants in the Clark Fork River Near Missoula, MT,
W83-03617 5B

Engineering Wetlands: Circulation, Sedimentation, and Water Quality,
W83-03693 2L

Water Quality in the Firth of Forth,
W83-03784 5D

Modelling a River Water Quality System: A Case Study of Tanshui River in Taiwan,
W83-03847 5G

Water Quality Management in Asia: Basic Issues and Priorities,
W83-03849 5G

WATER QUALITY CONTROL

Results of Lake Cleanup in the Order-Havel Catchment Areas (Ergebnisse Der Seesanierung Aus Dem Einzugsgebiet Der Wwd Order-Havel),
W83-03516 5G

Reservoir Eutrophication and Management,
W83-03629 5G

Changing the Clean Water Act: Reflections on the Long-Term.
W83-03635 6E

Caco3 Neutralization of Acidified Surface Waters,
W83-03834 5G

The Comprehensive Water Quality Management Program for the Laguna De Bay in the Philippines,
W83-03843 5G

Indices for Water Quality Assessment in Rivers: A Case Study of the Linggi River in Malaysia,
W83-03844 5A

Strategies for Water Quality Management in the Chao Phraya River in Thailand,
W83-03845 5G

Recent Developments on Stochastic Programming Model for Water Quality Management,
W83-03846 5G

Establishing Water Quality Objectives and Emission Targets in Rivers,
W83-03848 5G

WATER QUALITY INDICES

Indices for Water Quality Assessment in Rivers: A Case Study of the Linggi River in Malaysia,
W83-03844 5A

WATER QUALITY STANDARDS

Alternative Methods of Estimating Pollutant Loads in Flowing Water,
W83-03557 5A

Water Quality of Airport Storm Runoff, Phase II,
W83-03688 5B

The Estimation and Application of the Demand for Discharge Within the Context of Water Quality Management Systems,
W83-03701 6F

Industrial Wastewater Pretreatment Standards--A Local Approach,
W83-03765 6F

Environmental Quality Standards--New Problems for the Analyst,
W83-03798 5A

Mathematical Model for Management of Water Quality in Rivers: Application to the Yamaska River (Modele Mathematique De Gestion De La Qualite De L'Eau En Riviere: Application a La Riviere Yamaska),
W83-03839 5G

WATER RATES

The Feasibility of Engineering-Economic-Management Alternatives for Meeting Water Demands in Tupelo-Lee County, Mississippi,
W83-03722 6D

WATER RECYCLING

Innovative Technology Recycles Waste.
W83-03545 5D

WATER REQUIREMENTS

Groundwater Resources of the Texas Rio Grande Basin,
W83-03503 2F

A Research Agenda for Municipal Water Demand Forecasting,
W83-03640 6D

WATER RESEARCH INSTITUTES

Analysis of Critical Water Problems in the Northeastern United States to Determine Essential Research Requirements,
W83-03592 6B

WATER RESOURCES DEVELOPMENT

The Mid-Term Extension Program for the Bodensee-Wasserversorgung (Der Mittelfristige Ausbau Der Bodensee-Wasserversorgung),
W83-03523 5F

Salinity and Resource Development Problems in East Kent,
W83-03645 6G

WATER RETENTION

Calculating the Depths of Soil Moisture Control Sections From Laboratory Data,
W83-03780 2G

WATER REUSE

Innovative Technology Recycles Waste.
W83-03545 5D

Industrial Water Reuse with Coupled-Transport Membranes,
W83-03604 5D

Total Water Management--The Denver Story,
W83-03746 5D

WATER RIGHTS

Water Rights Transfers: A Legal, Economic, and Informational Analysis of Water in Oregon,
W83-03594 6E

Legal Analysis of the Lee County Water Supply Problem,
W83-03720 6E

Water Rights, Water Regulation, and the 'Taking Issue' in Hawaii,
W83-03779 6E

WATER RIGHTS TRANSFERS

Water Rights Transfers: A Legal, Economic, and Informational Analysis of Water in Oregon,
W83-03594 6E

WATER SAMPLING

Alternative Methods of Estimating Pollutant Loads in Flowing Water,
W83-03557 5A

WATER SHORTAGE

Increasing Rockport's Water Supply,
W83-03662 6D

WATER STORAGE

Stream-Water Storage in the Ocean Using an Impermeable Membrane,
W83-03772 3B

WATER STRESS

Optimum Water Use In Fruit Crop Production,
W83-03669 3F

The Effect of Excess and Limited Soil Moisture on Nitrogen Fixation of Several Leguminous Crops,
W83-03687 2I

WATER SUPPLY

Groundwater Resources of the Texas Rio Grande Basin,
W83-03503 2F

Stated Financing Policies of Government Agencies and the Experience of Rural Water Supply Systems,
W83-03606 6A

Water Quality of Airport Storm Runoff, Phase II,
W83-03688 5B

The Feasibility of Engineering-Economic-Management Alternatives for Meeting Water Demands in Tupelo-Lee County, Mississippi,
W83-03722 6D

WATER SUPPLY DEVELOPMENT

Growth of the Municipal Water System in Ciudad Juarez, Mexico,
W83-03502 5F

The Mid-Term Extension Program for the Bodensee-Wasserversorgung (Der Mittelfristige Ausbau Der Bodensee-Wasserversorgung),
W83-03523 5F

Geophysical Mapping Techniques for Groundwater Availability, Central Piedmont Province, North Carolina,
W83-03612 3B

Research Needs for Capacity Planning,
W83-03639 6D

Increasing Rockport's Water Supply,
W83-03662 6D

Water Harvesting for Afforestation: III. Dependence of Tree Growth on Amount and Distribution of Precipitation,
W83-03752 3B

Use of Natural Underground Reservoirs for Control of Surface Runoff,
W83-03758 4B

Predicting Future Water Demand,
W83-03835 6D

WATER TRANSFER

Water Transfers from Agriculture to Industry: Two Utah Examples,
W83-03821 6D

WATER TREAMENT

Removal of Radon from Water Using Granular Activated Carbon Adsorption,
W83-03564 5F

WATER TREATMENT

Bacterial Growth on Ion Exchange Resin - Investigations with a Strong Cationic Exchanger. Part 1: Attachment and Distribution of Bacteria: Operational Possibilities of Supressing Bacterial Growth (Bakterienwachstum Auf Ionenaustauscher-Harz-Untersuchungen an Einem Stark Sauren Kationen-Austauscher. Teil 1: Anhaftung Und Verteilung Der Bakterien; Betriebliche Moglichkeiten Der Wachstums-Unterdruckung),
W83-03507 5F

Methodology for Determining the Presence and Origin of Organic Micropollutants,
W83-03548 5F

The Elimination of Mineral Micropollutants,
W83-03556 5D

The Reactions of Chlorine Disinfectant With Organics Adsorbed on Granular Activated Carbon,
W83-03624 5F

Chloramines - An Answer to the Trihalomethane Problem,
W83-03625 5F

The History of Waste Detection in Severn-Trent Water Authority's Derwent Division,
W83-03654 5F

Modern Treatment in the Middle East.
W83-03764 5F

Sources of Trihalomethanes and Other C1 and C2 Halo-Organics in Potable Water,
W83-03799 5F

WATER TREATMENT FACILITIES
On the Methodology of Design and Use of Monitoring and Control Programs for Groundwater Management Facilities (Zur Methodik Des Aufbaus Und Der Nutzung Von Kontroll- Und Steuerungsprogrammen Von Grundwasserfassungsanlagen),
W83-03522 5F

Monitoring Water Quality Parameters from Municipal Water Intakes,
W83-03568 5F

The Mechanical and Electrical Aspects of the Remodeling of Kempton Park Works,
W83-03586 8C

WATER USE EFFICIENCY
Economical Water Use and Recovery of Valuable Materials by Means of Ion Exchangers in the Surface Finishing Industry (Wirtschaftliche Wasserverwendung Und Wertstoffruckgewinnung Durch Ionenaustauscher In Der Oberflachenveredelnden Industrie),
W83-03521 3E

Water-Use Production Functions of Selected Agronomic Crops in Northwestern New Mexico, Phase II,
W83-03560 2D

WATERSHED DEVELOPMENT
Development of Regional Wetland Restoration Goals: Coastal Wetlands,
W83-03691 6G

WATERSHED MANAGEMENT
Development of Regional Wetland Restoration Goals: Coastal Wetlands,
W83-03691 6G

Legal and Institutional Constraints and Opportunities in Wetlands Enhancement,
W83-03692 6E

Towards an Overall Strategy in Designing Wetland Restorations,
W83-03695 4D

WEATHER DATA COLLECTIONS
The Snowy Range Observatory: Climatological and Streamflow Data Report 1982,
W83-03675 7C

WEATHERING
Hydrogeochemical Investigations with Regard to the Origin of Heavy Metals in Groundwater (Hydrogeochemische Untersuchungen Zur Herkunft Von Schwermetallen Im Grundwasser),
W83-03511 2K

WEIRS
Performance Improvement with Broad-Crowned Spillways (Leistungssteigerung Breitkroniger Uberfalle),
W83-03518 8A

The Weinzodl Power Plant on the Mur (Das Murkraftwerk Weinzodl),
W83-03526 8A

Lake Weir Designed to Resist Ice Damage,
W83-03681 8A

WELL YIELD
Ground Water Yields and Availability in Fractured Crystalline Rocks, Wake County, North Carolina,
W83-03733 2F

WELLS
Deep Wells Don't Run Dry,
W83-03810 3B

WEST VIRGINIA
Evaluation of Acid-Mine-Water Generation and Acid-Mine-Drainage Potential of Coal and Coal-Associated Rocks,
W83-03820 5B

WETLANDS
Development of Regional Wetland Restoration Goals: Coastal Wetlands,
W83-03691 6G

Legal and Institutional Constraints and Opportunities in Wetlands Enhancement,
W83-03692 6E

Engineering Wetlands: Circulation, Sedimentation, and Water Quality,
W83-03693 2L

Restoration Techniques, Research, and Monitoring: Vegetation,
W83-03694 2L

Towards an Overall Strategy in Designing Wetland Restorations,
W83-03695 4D

WETTING
Two-Dimensional Exponential Infiltration Equations,
W83-03663 2G

WHEAT
Surface Soil Physical Properties After 36 Years of Cropping to Winter Wheat,
W83-03805 2J

WISCONSIN
An Institutional Perspective on the Use of Natural Resources and the Irrigation and Nitrate Contamination Problem,
W83-03587 6B

Here Comes the Water Bubble--Maybe,
W83-03634 5G

Impact of Snowmelt-Runoff from Agricultural Watersheds on Dissolved Oxygen,
W83-03636 5B

Silica in Lakes: Nutrient Competition, Equilibrium Reactions in Sediment Pore Waters, and Role in Metal Cycling,
W83-03699 2H

Levels of Nonpolar Organic Compounds in the Columbia Generating Station Cooling Pond,
W83-03717 5C

WYOMING
The Snowy Range Observatory: Climatological and Streamflow Data Report 1982,
W83-03675 7C

Evapotranspiration From Heterogeneous Mountain Meadows,
W83-03684 2D

Routing Graded Sediments in Streams: Applications,
W83-03832 2J

ZINC
Chemistry of the Springs of the Ozark Mountains, Northwestern Arkansas,
W83-03707 2K

ZONING
Water Conservation in Residential Development: Land-Use Techniques,
W83-03716 3D

ZOOPLANKTON
Vertical Distribution of Zooplankton in the Mologa River in Winter,
W83-03815 2H

AUTHOR INDEX

ADAN, B. L.
The Comprehensive Water Quality Management Program for the Laguna De Bay in the Philippines,
W83-03843 5G

ADEMILUYI, J. O.
Filtrability and Compressibility of Sludges, Part 1,
W83-03790 5E

AIPA, N.
Water Rights, Water Regulation, and the 'Taking Issue' in Hawaii,
W83-03779 6E

AKSIRAY, F.
Environmental Limiting Factors Affecting the Growth and Spread of Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur Lake (Die Umweltfaktoren, Die Die Verbreitung Und Entwicklung Von Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur-See Begrenzen),
W83-03543 5C

AL-DURRAH, M. M.
Parameters for Describing Soil Detachment Due to Single Waterdrop Impact,
W83-03750 2J

ALBERTSON, O. E.
Fine-Coal-Aided Centrifugal Dewatering of Waste Activated Sludge,
W83-03659 5E

ALBRECHT, S. L.
The Effect of Excess and Limited Soil Moisture on Nitrogen Fixation of Several Leguminous Crops,
W83-03687 2I

ALDOUS, K. M.
2,3,7,8-Tetrachlorodibenzo-p-Dioxin in Sediment Samples From Love Canal Storm Sewers and Creeks,
W83-03814 5A

ALEXANDER, M.
Effect of Simulated Acid Precipitation on Algal Fixation of Nitrogen and Carbon Dioxide in Forest Soils,
W83-03797 5C

ALIFEROV, A. N.
Use of Natural Underground Reservoirs for Control of Surface Runoff,
W83-03758 4B

ALLAN, G. R.
Engineering and Legal Ramifications of Groundwater Contamination - A Case Study,
W83-03626 5G

ALLEE, D. J.
Stated Financing Policies of Government Agencies and the Experience of Rural Water Supply Systems,
W83-03606 6A

ALLEN, R. T.
Managing the Risk and Liability of Toxic Contamination of Water Supply,
W83-03630 6F

ALLGOOD, G. S.
Nitrogen Fixation and Denitrification in the Pamlico River, North Carolina,
W83-03712 5B

ALMY, C. C. JR.
Geophysical Mapping Techniques for Groundwater Availability, Central Piedmont Province, North Carolina,
W83-03612 3B

ALONSO, C. V.
Routing Graded Sediments in Streams: Applications,
W83-03832 2J

Routing Graded Sediments in Streams: Formulations,
W83-03833 2J

ANAND, S. C.
A Finite Element Model to Predict the Flow of Underground Contaminants Due to Leakage of Chemical and/or Radioactive Material From a Buried Containment,
W83-03672 5B

ANAZODO, U. G. N.
Filtrability and Compressibility of Sludges, Part 1,
W83-03790 5E

ANDERSON, K. J.
Water Quality in the Firth of Forth,
W83-03784 5D

ANDERSON, M. A.
Silica in Lakes: Nutrient Competition, Equilibrium Reactions in Sediment Pore Waters, and Role in Metal Cycling,
W83-03699 2H

ANDREN, A. W.
Levels of Nonpolar Organic Compounds in the Columbia Generating Station Cooling Pond,
W83-03717 5C

ANNAN, A. P.
Electromagnetic Determination of Soil Water Content Using TDR: I. Applications to Wetting Fronts and Steep Gradients,
W83-03766 7B

Electromagnetic Determination of Soil Water Content Using TDR: II. Evaluation of Installation and Configuration of Parallel Transmission Lines,
W83-03806 7B

ARBUCKLE, W. B.
Determination of Biomass MLVSS in Pact Sludges,
W83-03570 5D

ARMSTRONG, D. E.
Silica in Lakes: Nutrient Competition, Equilibrium Reactions in Sediment Pore Waters, and Role in Metal Cycling,
W83-03699 2H

ARTHUR, J. W.
Acidification Effects on Macroinvertebrates and Fathead Minnows (Pimephales Promelas) in Outdoor Experimental Channels,
W83-03532 5C

ASUKA, M.
Stream-Water Storage in the Ocean Using an Impermeable Membrane,
W83-03772 3B

ATKINSON, D.
Increasing Rockport's Water Supply,
W83-03662 6D

BABANAZAROV, T. R.
Rate of Denitrification in Water Bodies of an Irrigation System and Soil of Rice Fields in the Kara Kalpuk ASSR,
W83-03760 5B

BABCOCK, W. C.
Industrial Water Reuse with Coupled-Transport Membranes,
W83-03604 5D

Novel Composite Membranes,
W83-03678 3A

BACON, E. J.
The Effects of Forest Harvest on Water Quality and Aquatic Life (Phase I),
W83-03686 4D

BADOV, V. V.
Combined Movement of Groundwaters and Moisture of the Zone of Aeration,
W83-03[illegible] 2F

BAKASTOV, S. S.
Vertical Distribution of Zooplankton in the Mologa River in Winter,
W83-03815 2H

BARCELONA, M. J.
Dredged Sediment for Agriculture: Lake Paradise, Mattoon, Illinois,
W83-03558 3F

BARROW, L. H.
Teacher's Resource Guide on Acidic Precipitation with Laboratory Activities,
W83-03565 2K

BARSS, R. P.
Novel Composite Membranes,
W83-03678 3A

BARTH, C. L.
Animal Feedlot Runoff in the Piedmont,
W83-03775 5B

BASER, R. E.
A Survey of Soils Irrigated With Arkansas River Water,
W83-03589 3C

BATERIDGE, T.
Salt Status of Glacial Till Soils of North-Central Montana as Affected by the Crop-Fallow System of Dryland Farming,
W83-03769 2G

BATHURST, J.
Direct Measurements of Secondary Currents in Natural Meander (Direktmessung Von Sekundarstromungen In Natuerlichen Maandern),
W83-03525 2E

BATSEL, K. R.
The Reactions of Chlorine Disinfectant With Organics Adsorbed on Granular Activated Carbon,
W83-03624 5F

BAUMGARTNER, B.
Development of a Regional Sludge Dewatering Facility Using Pressure Filters,
W83-03661 5E

BAUMGARTNER, I.
Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria/F. R. G. 1. Simple Methods for Calculating 'Acidic Aggressiveness' and Carbonate Dissolution Tendency (Kalk-Kohlensaure-Gleicgewicht in Oberflachennahen Grundwassern Nordostbayerns I. Einfache Gleichgewichtsberechnungen Zur 'Saureaggfressivitat' Und Kalklosungstendenz),
W83-03512 2K

Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria. II. Spatial and Temporal Variances (Kalk -Kohlensaure Gleichgewicht in Oberflachennahen Grundwassern Nordostbayerns. II. Zur Hydrochemischen Raumlichen Und Zeitlichen Varianz),
W83-03514 2K

BAUN, K.
Alternative Methods of Estimating Pollutant Loads in Flowing Water,
W83-03557 5A

BAXTER, K. M.
Organic Micropollutants in Effluent Recharge to Groundwater,
W83-03553 5B

BECK, R.
Building Sewer Renovation--A Key to Successful I/I Control,
W83-03747 5D

BECKER, R. H.
Displacement of Recreational Users Between the Lower St. Croix and Upper Mississippi Rivers,
W83-03842 6D

BECKETT, D. C.
Macroinvertebrate Colonization of Multiplate Samplers in the Ohio River: The Effect of Dams,
W83-03824 6G

BEER, C. R.
How Much Preventive Maintenance is too Much,
W83-03638 5D

BELL, J. M.
Total Organic Halogen (TOX) Concentrations in the West Lafayette Wastewater Treatment Plant Effluent and the Wabash River,
W83-03819 5E

BELSER, R. L.
Anaerobic Digestion of Waste Activated Sludge,
W83-03827 5D

BEN AIM, R.
Hydrocarbon Removal in a Three-Phase Fluidized Experimental Bed and Modelling of the Process (Epuration Hydrocarbonne en Couche Fluidisee Triphasique Etude Experimentale et Modelisation),
W83-03531 5D

BENEDICT, B. A.
Movement of Salt and Hazardous Contaminants in Groundwater Systems,
W83-03619 5B

BENNETT, J. M.
The Effect of Excess and Limited Soil Moisture on Nitrogen Fixation of Several Leguminous Crops,
W83-03687 2I

BENNINGER, L. K.
Sources and Fates of Sedimentary Organic Matter in the White Oak and Neuse River Estuaries,
W83-03590 5B

BERGER, B. B.
Evaluation of Alternative Procedures for Review of Water Resources Research Proposals,
W83-03600 9D

BERTINUSON, T.
Acid Rain: Sources and Effects in Connecticut Report of the Acid Rain Task Force,
W83-03561 2K

BEST, G. A.
Environmental Quality Standards--New Problems for the Analyst,
W83-03798 5A

BHADRA, B. P.
Water Rights Transfers: A Legal, Economic, and Informational Analysis of Water in Oregon,
W83-03594 6E

BISWAS, B. C.
Probabiliity Analysis of Short Period Rainfall in Dry Farming Tract in India,
W83-03800 2B

BJORKE, M. D.
Second Row Molecular Orbital Calculations. 5. A Minimal Basis Indo for Na-Cl,
W83-03613 1B

BLACK, R. G.
Discussion: Minimum Specific Energy in Compound Open Channel,
W83-03653 8B

BLATCHLEY, R. K.
Discussion: Residential Water Conservation,
W83-03658 3D

BOAST, C. W.
A 'Micro-Lysimter' Method for Determining Evaporation From Bare Soil: Description and Laboratory Evaluation,
W83-03783 2D

BODVARSSON, G. S.
Injection and Thermal Breakthrough in Fractured Geothermal Reservoirs,
W83-03585 2F

BOLAND, J. J.
A Research Agenda for Municipal Water Demand Forecasting,
W83-03640 6D

BOLLRICH, G.
Performance Improvement with Broad-Crowned Spillways (Leistungssteigerung Breitkroniger Uberfalle),
W83-03518 8A

BOONE, R. L.
Relationships Among Precipitation, Snowmelt, Subsurface Flow, Groundwater Recharge, and Streamflow Generation in the Clear Creek Watershed, Eastern Sierra Nevada,
W83-03822 2A

BORAH, D. K.
Routing Graded Sediments in Streams: Applications,
W83-03832 2J

Routing Graded Sediments in Streams: Formulations,
W83-03833 2J

BORNHOLDT, J.
Irrigation Funding Now More Rational,
W83-03811 6F

BORRELLI, J.
Evapotranspiration From Heterogeneous Mountain Meadows,
W83-03684 2D

BOSSET, E.
Evolution of Nitrate Concentrations in Groundwater in the Middle Vaud Region (Switzerland) (Evolution Des Concentrations en Nitrates Des Eaux Souterraines Du Moyen-Pays Vaudois),
W83-03508 5B

BOUMA, J.
Measuring the Hydraulic Conductivity of Soil Horizons With Continuous Macropores,
W83-03754 2G

BOWERS, E.
The Interior Surface of Galvanized Steel Pipe: A Potential Factor in Corrosion Resistance,
W83-03650 8G

BRADEN, J. B.
Administrative Coordination in the Implementation of Agricultural Nonpoint Pollution Controls,
W83-03559 6E

BRADFORD, J. M.
Parameters for Describing Soil Detachment Due to Single Waterdrop Impact,
W83-03750 2J

BRADLEY, M.
A Comparative Evaluation of Ground-Water Management Techniques,
W83-03704 4B

BRADLEY, R. M.
The Masonry Sewers of Aleppo,
W83-03655 5D

BRADSHAW, D.
Significance of Floodplain Sediments in Nutrient Exchange Between a Stream and its Floodplain,
W83-03724 2H

BRAMMER, D. B.
Institutional Framework for Conjunction Use of Surface and Groundwater in Tupelo-Lee County, Mississippi: Phase II,
W83-03721 4B

BRATBY, J.
Batch Flotation Tests: How Useful are They.,
W83-03549 5D

BRATBY, J. R.
Treatment of Raw Wastewater Overflows by Dissolved-Air Flotation,
W83-03575 5D

BRENNIMAN, G. R.
Enumeration of Chlorine-Damaged Fecal Coliforms in Wastewater Effluents,
W83-03632 5D

BRESLER, E.
Soil Parameters and Sampling Scheme for Characterizing Soil Hydraulic Properties of a Watershed,
W83-03817 2G

Statistical Analysis of Crop Yield Controlled Line-Source Irrigation,
W83-03753 3F

BRIDLE, T. R.
Discussion of: Industrial Wastes as Carbon Sources in Biological Denitrification,
W83-03576 5D

BRIERS, J. H.
Harvesting of Algae Grown on Raw Sewage,
W83-03737 5D

BRILL, E. D. JR.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W83-03580 6A

BRINSON, M. M.
Biogeochemistry of the Sediments of the Pamlico and Neuse River Estuaries, North Carolina,
W83-03620 2L

Significance of Floodplain Sediments in Nutrient Exchange Between a Stream and its Floodplain,
W83-03724 2H

BRITTER, R. E.
Separation of Hydraulic Flow Over Topography,
W83-03830 8B

BRITZ, A.
Water pollution Due to Industrial Trout Production in Fish Farms (Gewasserbelastung Durch Industriemassige Forellenproduktion in Rinnenanlagen),
W83-03520 5B

BROMLEY, D. W.
An Institutional Perspective on the Use of Natural Resources and the Irrigation and Nitrate Contamination Problem,
W83-03587 6B

BROWN, D. J.
Effect of Seepage from Unlined Municipal Waste Stabilization Lagoons on Chemical Quality of Groundwater in Shallow Aquifers,
W83-03731 5B

BROWN, H. J.
Land Application of Sewage Sludge Landfill Leachate,
W83-03563 5E

BRUTSAERT, W. H.
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

BUESINK, K. D.
Total Organic Halogen (TOX) Concentrations in the West Lafayette Wastewater Treatment Plant Effluent and the Wabash River,
W83-03819 5E

BUHR, H. O.
A Dynamic Model of the High-Rate Algal-Bacterial Wastewater Treatment Pond,
W83-03534 5D

BURCHFIELD, K.
Sampling and Analysis of Industrial Benthic Polynuclear Aromatic Hydrocarbons in Industrialized Urban Watersheds,
W83-03726 5A

BURKE, C. B.
Occurrence Probabilities of Antecedent Moisture Condition Classes in Indiana,
W83-03818 2A

BURMAN, R. D.
Evapotranspiration From Heterogeneous Mountain Meadows,
W83-03684 2D

BUYDOS, J. F.
Effect of Polyelectrolytes on Biofilm Growth,
W83-03826 5D

BYRD, P. E.
Studies in Dye-Tracing Techniques and Karst Hydrogeology,
W83-03599 5B

CABANISS, S. E.
The Effects of Bottom Water Anoxia on Benthnic Nutrient Flux Rates in the Pamlico River,
W83-03713 5C

CABELLI, V. J.
Enterococci and Other Microbial Indicators in Municipal Wastewater Effluents,
W83-03551 5A

CAHOON, D. D.
Biogeochemistry of the Sediments of the Pamlico and Neuse River Estuaries, North Carolina,
W83-03620 2L

CAMPANA, M. E.
A Parametric Model for Peak Flow Prediction in Ungaged Ephemeral Watersheds,
W83-03778 2A

Relationships Among Precipitation, Snowmelt, Subsurface Flow, Groundwater Recharge, and Streamflow Generation in the Clear Creek Watershed, Eastern Sierra Nevada,
W83-03822 2A

CAMPBELL, J. C.
Enzymatic Pretreatment of Pulp Mill Effluents Prior to Decolorization by Lime Precipitation,
W83-03603 5D

CAMPBELL, P. C.
Alternative Wastewater Management Strategies for Rural and Urban-Fringe Communities,
W83-03823 5D

CAMPBELL, P. G. C.
Mathematical Model for Management of Water Quality in Rivers: Application to the Yamaska River (Modele Mathematique De Gestion De La Qualite De L'Eau En Riviere: Application a La Riviere Yamaska),
W83-03839 5G

CARTER, G. E. JR.
1,2-Dibromo-3-Chloropropane Residues in Water in South Carolina, 1970-80,
W83-03744 5B

CARY, S. V.
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

CASTAGNA, A.
Heavy Metal Distribution in Sediments from the Gulf of Catania (Italy),
W83-03803 5B

CENTENO, J. D.
The Comprehensive Water Quality Management Program for the Laguna De Bay in the Philippines,
W83-03843 5G

CHAMBON, P.
Survey of Trihalomethane Levels in Rhone-Alps Water Supplies. Estimates on the Formation of Chloroform in Wastewater Treatment Plants and Swimming Pools,
W83-03540 5B

CHAMBON, R.
Survey of Trihalomethane Levels in Rhone-Alps Water Supplies. Estimates on the Formation of Chloroform in Wastewater Treatment Plants and Swimming Pools,
W83-03540 5B

CHANG, F-H.
Effect of Simulated Acid Precipitation on Algal Fixation of Nitrogen and Carbon Dioxide in Forest Soils,
W83-03797 5C

CHANG, W. B. C.
Water Rights, Water Regulation, and the 'Taking Issue' in Hawaii,
W83-03779 6E

CHANOUX, J. K.
Groundwater Protection on the Local Level: Integrating the Fragments of Regulation,
W83-03628 5G

CHARBENEAU, R. J.
Groundwater Resources of the Texas Rio Grande Basin,
W83-03503 2F

CHARLOU, J. L.
Toxicity of Organolead Compounds: Study of Bacterial Inactivation by Measurement of ATP (Approche De La Toxicite Des Organo Plombs Etude De L'Inactivation Bacterienne Par Mesures D'ATP),
W83-03510 5C

CHATIB, B.
Hydrocarbon Removal in a Three-Phase Fluidized Experimental Bed and Modelling of the Process (Epuration Hydrocarbonne en Couche Fluidisee Triphasique Etude Experimentale et Modelisation),
W83-03531 5D

CHATTERJI, P. C.
A Severe Flood in Luni Basin, Western Rajasthan During July 1979--A Case Study,
W83-03808 2E

CHAUSSEPIED, M.
Toxicity of Organolead Compounds: Study of Bacterial Inactivation by Measurement of ATP (Approche De La Toxicite Des Organo Plombs Etude De L'Inactivation Bacterienne Par Mesures D'ATP),
W83-03510 5C

CHITTENDEN, D. M. II.
Factors Affecting the Soluble-Suspended Distribution of Strontium-90 and Cesium-137 in Dardanelle Reservoir, Arkansas,
W83-03795 5B

CHOW, S. T.
The Biodegradation of N-Methyl-2-Pyrrolidone in Water by Sewage Bacteria,
W83-03538 5D

CHRISTENSEN, V.
Innovative Approaches to Sewage Collection, Treatment, and Disposal: Practices in Northern Canada,
W83-03840 5D

CHRISTOPHER, S. A.
Industrial Wastewater Pretreatment Standards--A Local Approach,
W83-03765 6F

CHUI, T. W.
Pollutant Loading Model for Highway Runoff,
W83-03829 5B

CHUNG, S. O.
Two-Dimensional Exponential Infiltration Equations,
W83-03663 2G

CIVCO, D. L.
Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

CLARK, C. S.
Atmospheric Release of Chlorinated Organic Compounds from the Activated Sludge Process,
W83-03583 5D

CLARK, D. M.
The Mechanical and Electrical Aspects of the Remodeling of Kempton Park Works,
W83-03586 8C

CLARK, L.
Organic Micropollutants in Effluent Recharge to Groundwater,
W83-03553 5B

CLARK, R. M.
Predicting Future Water Demand,
W83-03835 6D

Research Needs for Water Supply Cost Estimating,
W83-03648 6B

CLOTHEIR, B. E.
Constant-Flux Infiltration From a Hemispherical Cavity,
W83-03782 2G

COLLINS, R.
Investigation of Polycyclic Aromatic Hydrocarbons in Water Systems,
W83-03591 5A

CONSOLE, E.
Heavy Metal Distribution in Sediments from the Gulf of Catania (Italy),
W83-03803 5B

COOTE, D. R.
Agriculture and Water Quality in the Canadian Great Lakes Basin: III. Phosphorus,
W83-03841 5B

CORNEAU, D. G. M.
Assessment of Heavy Metals and PCBs at Sludge Application Sites,
W83-03633 5E

COUCHAT, P.
Heavy Water Tracing of Soil-Water Transfers Under Irrigation,
W83-03755 2G

CROMARTIE, K. D.
Coastal Pollution from Septic Tank Drainfields,
W83-03836 5B

CROMBIE-QUILTY, M. B.
The Adsorption of Bovine Serum Albumin by Activated Sludge,
W83-03533 5D

CUMMING, R. B.
Micropollutants Produced by Disinfection of Wastewater Effluents,
W83-03546 5D

DAGAN, G.
Statistical Analysis of Crop Yield Controlled Line-Source Irrigation,
W83-03753 3F

DAUGHERTY, L. A.
Calculating the Depths of Soil Moisture Control Sections From Laboratory Data,
W83-03780 2G

DAVIS, G. J.
Biogeochemistry of the Sediments of the Pamlico and Neuse River Estuaries, North Carolina,
W83-03620 2L

DAVIS, J. L.
Electromagnetic Determination of Soil Water Content Using TDR: I. Applications to Wetting Fronts and Steep Gradients,
W83-03766 7B

Electromagnetic Determination of Soil Water Content Using TDR: II. Evaluation of Installation and Configuration of Parallel Transmission Lines,
W83-03806 7B

DAVIS, J. M.
Variations in Monthly Precipitation Over North Carolina,
W83-03598 7C

DAVIS, R. D.
Influence of Micropollutants on Vegetation,
W83-03552 5C

DAVIS, S. N.
Measurement, Prediction, and Hazard Evaluation of Earth Fissuring and Subsidence Due to Ground-Water Overdraft,
W83-03668 2F

DIGIANO, F. A.
Discussion of: Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds and Nitrogen Dynamics in Waste Stabilization Ponds,
W83-03573 5D

DOHRMAN, J. A.
Source Protection - An Ounce of Prevention,
W83-03627 5G

DOWDING, M. R.
The Mechanical and Electrical Aspects of the Remodeling of Kempton Park Works,
W83-03586 8C

DRAPER, D. W.
Agriculture and Water Quality in the Canadian Great Lakes Basin: III. Phosphorus,
W83-03841 5B

DRISCOLL, C. T.
Caco3 Neutralization of Acidified Surface Waters,
W83-03834 5G

DUBE, S. K.
On the Role of Large Scale Energetics in the Onset and Maintenance of Summer Monsoon--II: Moisture Budget,
W83-03786 2B

DUDA, A. M.
Coastal Pollution from Septic Tank Drainfields,
W83-03836 5B

DUGAN, G. L.
Water Quality of Airport Storm Runoff, Phase II,
W83-03688 5B

DULLEA, M. A.
Chloramines - An Answer to the Trihalomethane Problem,
W83-03625 5F

DUNNICLIFF, J.
Discussion: Long-Term Performance of Embankment Dam Instrumentation,
W83-03642 8G

DWORKIN, J. M.
A Comparative Evaluation of Ground-Water Management Techniques,
W83-03704 4B

EDER, B. K.
Variations in Monthly Precipitation Over North Carolina,
W83-03598 7C

EDWARDS, G. L.
Measurement and Validity of Oxygen Uptake as an Activated Sludge Process Control Parameter,
W83-03569 5D

EGBUNIWE, N.
Filtrability and Compressibility of Sludges, Part 1,
W83-03790 5E

EGLOFF, D. A.
Monitoring Water Quality Parameters from Municipal Water Intakes,
W83-03568 5F

EKERN, P. C.
Mineralogy of Sediments in Three Estuaries on Oahu, Hawaii,
W83-03728 2L

ELIA, V. J.
Atmospheric Release of Chlorinated Organic Compounds from the Activated Sludge Process,
W83-03583 5D

ELMALEH, S.
Hydrocarbon Removal in a Three-Phase Fluidized Experimental Bed and Modelling of the Process (Epuration Hydrocarbonne en Couche Fluidisee Triphasique Etude Experimentale et Modelisation),
W83-03531 5D

ELRICK, D. E.
Hydrodynamic Dispersion Involving Cationic Adsorption During Unsaturated, Transient Water Flow in Soil,
W83-03749 2G

ELZERMAN, A. W.
Effects of Acid Deposition (Rain) on a Piedmont Aquatic Ecosystem: Acid Inputs, Neutralization, and pH Changes,
W83-03700 5C

Solubilization Rate of Atmospheric Particulate Matter and Impact on Water Quality,
W83-03677 5B

EMEL, J. L.
A Comparative Evaluation of Ground-Water Management Techniques,
W83-03704 4B

ENGLE, P.
Discussion: Flow Resistance in Coarse Gravel Bed Rivers,
W83-03644 8B

ERICKSON, R.
Levels of Nonpolar Organic Compounds in the Columbia Generating Station Cooling Pond,
W83-03717 5C

EVANS, D. D.
Hydrologic Evaluation of Small Impoundments in Arid and Semiarid Regions,
W83-03667 6G

FALTER, C. M.
The Fate, Distribution and Limnological Effects of Volcanic Tephra in the St. Joe and Coeur D'Alene River Deltas of Lake Coeur D'Alene, Idaho,
W83-03597 5B

FAN, P-F.
Mineralogy of Sediments in Three Estuaries on Oahu, Hawaii,
W83-03728 2L

FAUST, C. R.
Management Model for Power Production From a Geothermal Field: 1. Hot Water Reservoir and Power Plant Model,
W83-03761 8A

FAY, L. E.
A Study of the Occurrence of Hydrogen Sulfide in Sewers in the Piedmont Area of South Carolina,
W83-03671 8G

FEHRENBACHER, J. B.
Dredged Sediment for Agriculture: Lake Paradise, Mattoon, Illinois,
W83-03558 3F

FERGUSON, H.
Salt Status of Glacial Till Soils of North-Central Montana as Affected by the Crop-Fallow System of Dryland Farming,
W83-03769 2G

FERRARA, R. A.
Discussion of: Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds and Nitrogen Dynamics in Waste Stabilization Ponds,
W83-03573 5D

FILIPPINI, M. G.
The Impact of Urbanization on a Flood-Plain Aquifer: Bloomington, Indiana,
W83-03609 5B

FISCHER, H. B.
Currents in South San Francisco Bay,
W83-03690 5B

FISCHWASSER, K.
Economical Water Use and Recovery of Valuable Materials by Means of Ion Exchangers in the Surface Finishing Industry (Wirtschaftliche Wasserverwendung Und Wertstoffruckgewinnung Durch Ionenaustauscher In Der Oberflachenveredelnden Industrie),
W83-03521 3E

FLEMMING, H-C.
Bacterial Growth on Ion Exchange Resin - Investigations with a Strong Cationic Exchanger. Part 1: Attachment and Distribution of Bacteria: Operational Possibilities of Supressing Bacterial Growth (Bakterienwachstum Auf Ionenaustauscher-Harz-Untersuchungen an Einem Stark Sauren Kationen-Austauscher. Teil 1: Anhaftung Und Verteilung Der Bakterien; Betriebliche Moglichkeiten Der Wachstums-Unterdruckung),
W83-03507 5F

FLINSPACH, D.
Development of Suitable Closure Specifications for Remote Controlled Ball Valves to Limit Water Hammer in Pipelines of the Zweckverband Landeswasserversorgung Stuttgart (Entwicklung Geeigneter Schliessgesetze Zur Druckstossbegranzung Bei Ferngesteuerten Kugelschiebern In Den Fernwasserleitung Des Zweckverbandes Landeswasserversorgung Stuttgart),
W83-03524 8C

FLYNN, K. C.
Here Comes the Water Bubble--Maybe,
W83-03634 5G

FOK, Y. S.
Stream-Water Storage in the Ocean Using an Impermeable Membrane,
W83-03772 3B

Two-Dimensional Exponential Infiltration Equations,
W83-03663 2G

FOLLIOTT, P. F.
Simulation of Nutrient, Microorganism, and Heavy Metal Transport Capacity of Suspended Sediment,
W83-03732 2J

FORD, J. I.
Population Biology in Small Hawaiian Streams,
W83-03676 6G

FOX, K. P.
The Interior Surface of Galvanized Steel Pipe: A Potential Factor in Corrosion Resistance,
W83-03650 8G

FOY, G.
Maintenance Dredging in the Port of Bristol,
W83-03539 8C

FRANZ, D. D.
Discussion: Minimum Specific Energy in Compound Open Channel,
W83-03653 8B

FREVERT, T.
Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria/F. R. G. 1. Simple Methods for Calculating 'Acidic Aggressiveness' and Carbonate Dissolution Tendency (Kalk-Kohlensaure-Gleicgewicht in Oberflachennahen Grundwassern Nordostbayerns I. Einfache Gleichgewichtsberechnungen Zur 'Saureaggfressivitat' Und Kalklosungstendenz),
W83-03512 2K

Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria. II. Spatial and Temporal Variances (Kalk -Kohlensaure Gleichgewicht in Oberflachennahen Grundwassern Nordostbayerns. II. Zur Hydrochemischen Raumlichen Und Zeitlichen Varianz),
W83-03514 2K

FRINK, C. A.
Acid Rain: Sources and Effects in Connecticut Report of the Acid Rain Task Force,
W83-03561 2K

FRNKA, R. L.
The Feasibility of Engineering-Economic-Management Alternatives for Meeting Water Demands in Tupelo-Lee County, Mississippi,
W83-03722 6D

FUJIMURA, F. N.
Water Resources Bibliography of Hawaii,
W83-03730 10C

FUQUA, B. D.
Optimum Water Use In Fruit Crop Production,
W83-03669 3F

GALEZIEWSKI, T. M.
Filtration of Primary Effluent,
W83-03574 5D

GARRETT, W. R. JR.
Toxic Effects of Nitrite on Channel Catfish,
W83-03709 5C

GEE, H. K.
Stream-Water Storage in the Ocean Using an Impermeable Membrane,
W83-03772 3B

GENOT, J.
The Elimination of Mineral Micropollutants,
W83-03556 5D

GHOSH, A. K.
Hydrometeorological Study of Severe Rainstorms of North Bihar,
W83-03788 2B

GIAMBELLUCA, T. W.
Water Balance of the Pearl Harbor-Honolulu Basin, Hawaii, 1946-1975,
W83-03673 4B

GIESECKE, J.
Development of Suitable Closure Specifications for Remote Controlled Ball Valves to Limit Water Hammer in Pipelines of the Zweckverband Landeswasserversorgung Stuttgart (Entwicklung Geeigneter Schliessgesetze Zur Druckstossbegranzung Bei Ferngesteuerten Kugelschiebern In Den Fernwasserleitung Des Zweckverbandes Landeswasserversorgung Stuttgart),
W83-03524 8C

GILLEAN, J. I.
Predicting Future Water Demand,
W83-03835 6D

GILMOUR, J. T.
A Survey of Soils Irrigated With Arkansas River Water,
W83-03589 3C

GOBLET, C.
The Elimination of Mineral Micropollutants,
W83-03556 5D

GODSCHALK, D. R.
Making Waves: Public Participation in State Water Planning,
W83-03614 6F

GOEL, D. K.
Chemical Composition of Rain Water Over Lucknow in 1980,
W83-03809 2K

GOMEZ-FERRER, R. V.
Salt Transport in the Lower South Platte River,
W83-03718 5B

GOODE, S. R.
Development of a Chemical Analysis for Ultratrace Arsenic in Water,
W83-03567 5A

GOODRICH, J. A.
Predicting Future Water Demand,
W83-03835 6D

GORDON, C. C.
A Preliminary Investigation Into the Use of Crayfish as a Sensitive Species to Pollutants in the Clark Fork River Near Missoula, MT,
W83-03617 5B

GORDON, J.
Deep Wells Don't Run Dry,
W83-03810 3B

GORDON, M. S.
Second Row Molecular Orbital Calculations. 5. A Minimal Basis Indo for Na-Cl,
W83-03613 1B

GOSSETT, J. M.
Anaerobic Digestion of Waste Activated Sludge,
W83-03827 5D

GRAHAM, P. J.
Enumeration of Chlorine-Damaged Fecal Coliforms in Wastewater Effluents,
W83-03632 5D

GRANT, D. M.
An Evaluation of Seashore Mallow, Kosteletzkya Virginica (L.) Presl., as a Potential New Crop Which Can Be Grown in Brackish Water,
W83-03618 3C

GRASMICK, A.
Hydrocarbon Removal in a Three-Phase Fluidized Experimental Bed and Modelling of the Process (Epuration Hydrocarbonne en Couche Fluidisee Triphasique Etude Experimentale et Modelisation),
W83-03531 5D

GRAY, D. D.
Occurrence Probabilities of Antecedent Moisture Condition Classes in Indiana,
W83-03818 2A

GREEN, R. E.
Soil Parameters and Sampling Scheme for Characterizing Soil Hydraulic Properties of a Watershed,
W83-03817 2G

GREGORY, E. J.
Water-Use Production Functions of Selected Agronomic Crops in Northwestern New Mexico, Phase II,
W83-03560 2D

GREIDER, T. R.
Water Transfers from Agriculture to Industry: Two Utah Examples,
W83-03821 6D

GRIFFIN, R. C.
An Institutional Perspective on the Use of Natural Resources and the Irrigation and Nitrate Contamination Problem,
W83-03587 6B

GRIGGS, A. A.
Determination of Biomass MLVSS in Pact Sludges,
W83-03570 5D

GRIZZLE, J. M.
Effects on Channel Catfish of High Nitrite Concentrations That Occur in Fish Ponds,
W83-03698 5C

GROVES, F. R. JR.
Waste Water Treatment by Ligand Exchange,
W83-03706 5D

GRUBBS, R. B.
Discussion of: Effect of a Bacterial Culture Product on Biological Kinetics,
W83-03571 5D

GRZYBOWSKI, J.
Isolation, Identification, and Determination of Polycyclic Aromatic Hydrocarbons in Sewage,
W83-03794 5A

GUIRAUD, A.
Methodology for Determining the Presence and Origin of Organic Micropollutants,
W83-03548 5F

GUPTA, K. N.
Agro-Ecological Regions of Western Rajasthan,
W83-03850 2A

HADJIPANOS, P. A.
Discussion: Boundary Shear in Smooth and Rough Channels,
W83-03652 8B

HAJJAR, A.
The Masonry Sewers of Aleppo,
W83-03655 5D

HALLIDAY, M. C.
Water Quality in the Firth of Forth,
W83-03784 5D

HAMMERMEISTER, D. P.
Perched Water Tables on Hillsides in Western Oregon: I. Some Factors Affecting Their Development and Longevity,
W83-03768 2G

Perched Water Tables on Hillsides in Western Oregon: II. Preferential Downslope Movement of Water and Anions,
W83-03751 2G

HANDA, B. K.
Chemical Composition of Rain Water Over Lucknow in 1980,
W83-03809 2K

HANKS, R. J.
Statistical Analysis of Crop Yield Controlled Line-Source Irrigation,
W83-03753 3F

HANSON-WALTON, S. A.
Interactive Nonstructural Flood-Control Planning,
W83-03831 6F

HANVEY, W. H.
Animal Feedlot Runoff in the Piedmont,
W83-03775 5B

HARDEN, D.
Adaptation of an Activated Sludge Process to the Treatment of Coke-Plant Wastewater Containing High Levels of Cyanide,
W83-03710 5D

HARDER, F. J.
Inquiry into Tax gains for Members of Partnerships (Steuerliche Gewinnermittlung Bei Partnerwerken),
W83-03530 6C

HARPER, F. C.
Evaporative Cooling by Mist and Sprinkle Irrigation and Conserving Water in Vegetable Irrigation in Arizona,
W83-03729 3F

HARRISON, R. M.
Physico-Chemical Speciation of Selected Metals in the Treated Effluent of a Lead-Acid Battery Manufacturer and in the Receiving River,
W83-03544 5B

HEDUIT, A.
Tests on Aerators: Conclusions Drawn From 500 Clean Water Tests Conducted in 200 Different Sewage Treatment Plants - I Test Procedure (Essais D'Aerateurs Enseignements Tires De 500 Essais En Eu Clair Effectues Dans 200 Stations D'Epuration Differentes - I Methodologie),
W83-03535 5D

HEGG, R. O.
Animal Feedlot Runoff in the Piedmont,
W83-03775 5B

HENDRICKS, D. W.
Salt Transport in the Lower South Platte River,
W83-03718 5B

HERBERTSON, P. W.
Salinity and Resource Development Problems in East Kent,
W83-03645 6G

HERMANUTZ, R. O.
Acidification Effects on Macroinvertebrates and Fathead Minnows (Pimephales Promelas) in Outdoor Experimental Channels,
W83-03532 5C

HERSON, D. S.
The Effect of Stress on Organisms in the Distribution System,
W83-03602 5A

HEY, R.
Direct Measurements of Secondary Currents in Natural Meander (Direktmessung Von Sekundarstromungen In Natuerlichen Maandern),
W83-03525 2E

HICKEY, R. F.
Effect of Polyelectrolytes on Biofilm Growth,
W83-03826 5D

HILKER, D. R.
2,3,7,8-Tetrachlorodibenzo-p-Dioxin in Sediment Samples From Love Canal Storm Sewers and Creeks,
W83-03814 5A

HILL, R. L.
A Permeameter Which Eliminates Boundary Flow Errors in Saturated Hydraulic Conductivity Measurements,
W83-03770 7B

HIRSCH, M. S.
Disposal of Household Wastewater in Soils of High Stone Content,
W83-03679 5D

HOLBO, H. R.
A Dew-Point Hygrometer for Field Use,
W83-03796 7B

HOLMES, R. N.
Significance of Floodplain Sediments in Nutrient Exchange Between a Stream and its Floodplain,
W83-03724 2H

HOOPER, W. JR.
Legal Analysis of the Lee County Water Supply Problem,
W83-03720 6E

HOPKINS, L. D.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W83-03580 6A

HORLACHER, H. B.
Development of Suitable Closure Specifications for Remote Controlled Ball Valves to Limit Water Hammer in Pipelines of the Zweckverband Landeswasserversorgung Stuttgart (Entwicklung Geeigneter Schliessgesetze Zur Druckstossbegranzung Bei Ferngesteuerten Kugelschiebern In Den Fernwasserleitung Des Zweckverbandes Landeswasserversorgung Stuttgart),
W83-03524 8C

HORNE, A. J.
Effect of Copper on Nitrogen Fixation and Growth of Blue-Green Algae in Natural Plankton Associations,
W83-03837 5F

HORNER, R. R.
Pollutant Loading Model for Highway Runoff,
W83-03829 5B

HOUCK, C. P.
Development of a Regional Sludge Dewatering Facility Using Pressure Filters,
W83-03661 5E

HOUEIX, A.
Toxicity of Organolead Compounds: Study of Bacterial Inactivation by Measurement of ATP (Approche De La Toxicite Des Organo Plombs Etude De L'Inactivation Bacterienne Par Mesures D'ATP),
W83-03510 5C

HOULSBY, A. C.
Discussion: Long-Term Performance of Embankment Dam Instrumentation,
W83-03642 8G

HUANG, C. P.
Activated Carbon for Treatment of Cadmium Wastewater,
W83-03825 5D

HUANG, J. C.
An Innovative Approach of Operating Rotating Biological Contactor Using Pure Oxygen,
W83-03666 5D

HUANG, J. Y. C.
Variables Affecting Metal Removal from Sludge,
W83-03581 5E

HUBERT, P.
A Method To Compute River Heating - Application to the Management of Thermal Loadings to the Rhine River (Une Methode De Calcul De L'Echauffement Des Rivieres - Application a La Gestion Des Rejets Themiques Au Rhin),
W83-03584 5G

HUBERT, W. H.
Factors Influencing Dieldrin and DDT Residues in Carp from the Des Moines River, Iowa, 1977-80,
W83-03743 5B

HUCKLE, H. F.
Field Vs. Laboratory Determined Hydraulic Conductivities of Some Slowly Permeable Horizons,
W83-03781 2G

HUFFMAN, J. L.
Water Rights Transfers: A Legal, Economic, and Informational Analysis of Water in Oregon,
W83-03594 6E

HULTMAN, B.
Elimination of Organic Micropollutants,
W83-03547 5D

HUPPERT, H. E.
Separation of Hydraulic Flow Over Topography,
W83-03830 8B

IDELOVITCH, E.
Magnesium Recycling by Carbonation and Centrifugation of High-Lime Wastewater Sludge,
W83-03660 5E

IYER, N. V.
A Signal Recording and Printing System for Telemetering Raingauges,
W83-03801 7B

JACKSON, C.
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

JACQUEZ, R. B.
Preliminary Evaluation of the Pretreatment of Fuel Alcohol Fermentation Stillage Through an Anaerobic Filter,
W83-03664 5D

JANAUER, G. E.
An Investigation of the Chemistry of Degradation of Pesticides and Other Serious Organic Contaminants in Drinking Water for Application to Domestic and Community Water Supplies,
W83-03725 5F

JANOWICZ, J. R.
Regional Flood Frequency Analysis for Alaska,
W83-03611 2E

JARMAN, M. C.
Legal Analysis of the Lee County Water Supply Problem,
W83-03720 6E

JARRELL, W. M.
A Modified Line Source Sprinkler Technique for Continuous-Variable Leaching Studies,
W83-03767 3F

JEPPSON, R. W.
Hydraulics of Solving Unsteady Debris Flows,
W83-03608 8B

JOHNSON, J.
Investigation of Polycyclic Aromatic Hydrocarbons in Water Systems,
W83-03591 5A

JOHNSON, L. M.
Discussion of: Effect of a Bacterial Culture Product on Biological Kinetics,
W83-03571 5D

JOHNSON, R. A.
Use of Hydrocyclones to Treat Seafood-Processing Wastewaters,
W83-03572 5D

JOLLEY, R. L.
Micropollutants Produced by Disinfection of Wastewater Effluents,
W83-03546 5D

JONES, D. D.
Biological Treatment of Cyanide in High-Strength Coke-Plant Wastewater,
W83-03697 5D

JONES, R. A.
Guidelines for Sampling Ground Water,
W83-03582 5A

JOSSELYN, M.
Restoration Techniques, Research, and Monitoring: Vegetation,
W83-03694 2L

JOYCE, T. W.
Enzymatic Pretreatment of Pulp Mill Effluents Prior to Decolorization by Lime Precipitation,
W83-03603 5D

JUDKINS, C. I. JR
Managing the Risk and Liability of Toxic Contamination of Water Supply,
W83-03630 6F

KALLSEN, C. E.
Water-Use Production Functions of Selected Agronomic Crops in Northwestern New Mexico, Phase II,
W83-03560 2D

KANE, D. L.
Regional Flood Frequency Analysis for Alaska,
W83-03611 2E

KARUK, B. P.
Use of Natural Underground Reservoirs for Control of Surface Runoff,
W83-03758 4B

KAYNOR, E. R.
Evaluation of Alternative Procedures for Review of Water Resources Research Proposals,
W83-03600 9D

KEHEW, A. E.
Effect of Seepage from Unlined Municipal Waste Stabilization Lagoons on Chemical Quality of Groundwater in Shallow Aquifers,
W83-03731 5B

KEINATH, T. M.
Clarification Failure Control Strategies,
W83-03828 5D

KENDRA, W. R.
The Fate, Distribution and Limnological Effects of Volcanic Tephra in the St. Joe and Coeur D'Alene River Deltas of Lake Coeur D'Alene, Idaho,
W83-03597 5B

KENNARD, W. C.
Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

KERR, G. L.
The Snowy Range Observatory: Climatological and Streamflow Data Report 1982,
W83-03675 7C

KHAMBETE, N. N.
Probabiliity Analysis of Short Period Rainfall in Dry Farming Tract in India,
W83-03800 2B

KINCANNON, D. F.
Biological Treatability of Specific Organic Compounds Found in Chemical Industry Wastewaters,
W83-03550 5D

Removal Mechanisms for Toxic Priority Pollutants,
W83-03647 5D

KING, L. D.
A Permeameter Which Eliminates Boundary Flow Errors in Saturated Hydraulic Conductivity Measurements,
W83-03770 7B

KINZIE, R. A. III
Population Biology in Small Hawaiian Streams,
W83-03676 6G

KISELEV, A. A.
Combined Movement of Groundwaters and Moisture of the Zone of Aeration,
W83-03542 2F

KLING, G. F.
Perched Water Tables on Hillsides in Western Oregon: I. Some Factors Affecting Their Development and Longevity,
W83-03768 2G

Perched Water Tables on Hillsides in Western Oregon: II. Preferential Downslope Movement of Water and Anions,
W83-03751 2G

KLONTZ, G. W.
Aquaculture Techniques: A Computer Simulation of an Intensive Fish Culture System (Aqua),
W83-03685 8I

KLOOS, W.
Water Rights, Water Regulation, and the 'Taking Issue' in Hawaii,
W83-03779 6E

KNEEBONE, W. R.
Effect of Mowing Height Upon Consumptive Water Use, Groundwater Recharge and Recharge Quality from Bermudagrass Watered with Secondary Treated Effluent,
W83-03816 4B

KOCH, F.
Automatic Determination of Snow Cover (Schneedecke Automatisch Erfasst),
W83-03529 7B

KOPPER, M.
Fine-Coal-Aided Centrifugal Dewatering of Waste Activated Sludge,
W83-03659 5E

KORTH, M. S.
Second Row Molecular Orbital Calculations. 5. A Minimal Basis Indo for Na-Cl,
W83-03613 1B

KOWSAR, A.
Water Harvesting for Afforestation: III. Dependence of Tree Growth on Amount and Distribution of Precipitation,
W83-03752 3B

KRAYNICK, R. G.
Water Rights Transfers: A Legal, Economic, and Informational Analysis of Water in Oregon,
W83-03594 6E

KRONE, R. B.
Engineering Wetlands: Circulation, Sedimentation, and Water Quality,
W83-03693 2L

KROTHE, N. C.
The Impact of Urbanization on a Flood-Plain Aquifer: Bloomington, Indiana,
W83-03609 5B

KRUGER, W.
Studies on the Soil Application Treatment of Coking Plant Wastewater (Untersuchungen Zur Bodenbehandlung Von Kokereiabwasser),
W83-03519 5D

KRYLOVA, I. N.
Rate of Denitrification in Water Bodies of an Irrigation System and Soil of Rice Fields in the Kara Kalpuk ASSR,
W83-03760 5B

KUBUS, J. J.
Monitoring Water Quality Parameters from Municipal Water Intakes,
W83-03568 5F

KUGELMAN, I. J.
Evaluation of a Dissolved Oxygen Field Test Protocol,
W83-03631 7B

KULHAWY, F. H.
Factors Affecting Stress Cell Measurements in Soil,
W83-03657 8D

KULIKOV, G. V.
Some Current Problems in Investigations of the Interaction of Subsurface and Surface Waters of the USSR,
W83-03734 6D

KULIN, G.
Evaluation of a Dissolved Oxygen Field Test Protocol,
W83-03631 7B

KUMAR, A.
Chemical Composition of Rain Water Over Lucknow in 1980,
W83-03809 2K

KUNG, S.
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

KURENNOI, V. V.
Some Current Problems in Investigations of the Interaction of Subsurface and Surface Waters of the USSR,
W83-03734 6D

KUSTER, K.
The Biodegradation of BIS (Tributyltin) Oxide (TBTO) by Bilogical Sewage Treatment (Der Biologische Abbau Von Tributylzinnoxid (TBTO) in Einer Belebtschlammanlage),
W83-03506 5D

KUZ'MIN, S. S.
Comparative Evaluation of Mathematical Models Used for Calculating Biological Filters,
W83-03735 5D

LA MOTTA, E. J.
Effect of Polyelectrolytes on Biofilm Growth,
W83-03826 5D

LABADIE, J. W.
A River Basin Network Model for Conjunctive Use of Surface and Groundwater: Program CONSIM,
W83-03596 6A

LAQUIDARA, V. D.
Clarification Failure Control Strategies,
W83-03828 5D

LARNICOL, J.
Methodology for Determining the Presence and Origin of Organic Micropollutants,
W83-03548 5F

LARYEA, K. B.
Hydrodynamic Dispersion Involving Cationic Adsorption During Unsaturated, Transient Water Flow in Soil,
W83-03749 2G

LAURIA, D. T.
Research Needs for Capacity Planning,
W83-03639 6D

LAURITSEN, D. D.
The Freshwater Asian Clam (Corbicula Fluminea) as a Factor Affecting Nutrient Cycling in the Chowan River, N.C.,
W83-03588 5B

LAWRENCE, G. A.
Currents in South San Francisco Bay,
W83-03690 5B

LAXEN, D. P. H.
Physico-Chemical Speciation of Selected Metals in the Treated Effluent of a Lead-Acid Battery Manufacturer and in the Receiving River,
W83-03544 5B

LAZARO, R. C.
A River Basin Network Model for Conjunctive Use of Surface and Groundwater: Program CONSIM,
W83-03596 6A

LEE, E. K. L.
Novel Composite Membranes,
W83-03678 3A

LEE, G. F.
Guidelines for Sampling Ground Water,
W83-03582 5A

LEE, N. E.
Micropollutants Produced by Disinfection of Wastewater Effluents,
W83-03546 5D

LEFOR, M. W.
Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

LEMBI, C. A.
Integration of Management Methods with the Life Cycle and Ecology of the Filamentous Alga, Pithophora,
W83-03680 4A

LEMBKE, W. D.
Dredged Sediment for Agriculture: Lake Paradise, Mattoon, Illinois,
W83-03558 3F

LEMLEY, A. T.
An Investigation of the Chemistry of Degradation of Pesticides and Other Serious Organic Contaminants in Drinking Water for Application to Domestic and Community Water Supplies,
W83-03725 5F

LESTER, J. N.
Removal of Nitrilotriacetic Acid During Primary Sedimentation and Its Effect on Metal Removal,
W83-03813 5D

LETEY, J.
A Modified Line Source Sprinkler Technique for Continuous-Variable Leaching Studies,
W83-03767 3F

LEWIS, L. R.
Micropollutants Produced by Disinfection of Wastewater Effluents,
W83-03546 5D

LICHTIGFELD, S.
The Suitability of M-Endo-LES Agar for Total Coliform Counts by Membrane Filtration,
W83-03762 5A

LINDLEY, K. L.
Use of Hydrocyclones to Treat Seafood-Processing Wastewaters,
W83-03572 5D

LITSTER, J.
Column Design for Recovery of NH3 and CO2 from Wastewater in a Urea Plant,
W83-03748 5D

LITTLE, R. L.
Water Transfers from Agriculture to Industry: Two Utah Examples,
W83-03821 6D

LIU, C. C. K.
Two-Dimensional Exponential Infiltration Equations,
W83-03663 2G

LIU, Y. C.
An Innovative Approach of Operating Rotating Biological Contactor Using Pure Oxygen,
W83-03666 5D

LLOYD, W. J.
Growth of the Municipal Water System in Ciudad Juarez, Mexico,
W83-03502 5F

LOHANI, B. N.
Establishing Water Quality Objectives and Emission Targets in Rivers,
W83-03848 5G

Indices for Water Quality Assessment in Rivers: A Case Study of the Linggi River in Malaysia,
W83-03844 5A

Modelling a River Water Quality System: A Case Study of Tanshui River in Taiwan,
W83-03847 5G

Recent Developments on Stochastic Programming Model for Water Quality Management,
W83-03846 5G

Strategies for Water Quality Management in the Chao Phraya River in Thailand,
W83-03845 5G

Water Quality Management in Asia: Basic Issues and Priorities,
W83-03849 5G

LOMAKIN, E. A.
Numerical Modeling of Groundwater Flow Processes,
W83-03771 2F

LOMEN, D. O.
Trickle Irrigation - Modeling Water and Solutes,
W83-03777 2G

LONG, A.
Stable Isotopic Investigation of the Ground Water Quality and Transport Systems in the Safford Valley, Arizona,
W83-03674 2K

LONSDALE, H. K.
Novel Composite Membranes,
W83-03678 3A

LOVELL, W. H.
Industrial Wastewater Pretreatment Standards--A Local Approach,
W83-03765 6F

LOWRY, J. D.
Removal of Radon from Water Using Granular Activated Carbon Adsorption,
W83-03564 5F

LUCKNER, L.
On the Methodology of Design and Use of Monitoring and Control Programs for Groundwater Management Facilities (Zur Methodik Des Aufbaus Und Der Nutzung Von Kontroll- Und Steuerungsprogrammen Von Grundwasserfassungsanlagen),
W83-03522 5F

LURKER, P. A.
Atmospheric Release of Chlorinated Organic Compounds from the Activated Sludge Process,
W83-03583 5D

LYMAN, L.
Reservoir Eutrophication and Management,
W83-03629 5G

LYSMER, J.
Dynamic Analysis of Earth Dams in Three Dimensions,
W83-03651 8D

MACHESKY, M. L.
Silica in Lakes: Nutrient Competition, Equilibrium Reactions in Sediment Pore Waters, and Role in Metal Cycling,
W83-03699 2H

MACKAY, D.
Nature and Origin of Micropollutants,
W83-03555 5B

MADDOCK, T.
Management Model for Power Production From a Geothermal Field: 1. Hot Water Reservoir and Power Plant Model,
W83-03761 8A

MADDOCK, T. III
A Comparative Evaluation of Ground-Water Management Techniques,
W83-03704 4B

MALE, J. W.
River Basin Water Quality Monitoring Network Design,
W83-03593 5A

MALONEY, M. T.
The Estimation and Application of the Demand for Discharge Within the Context of Water Quality Management Systems,
W83-03701 6F

MANDAL, J. C.
Path of a Vortex in a Semi-Infinite Region With a Streaming Motion along a Plane Wall Boundary Having a Semicircular Bay or Bulge,
W83-03807 2E

MANN, P. C.
Water Pricing Research Needs,
W83-03649 6C

MAR, B. W.
Pollutant Loading Model for Highway Runoff,
W83-03829 5B

MARSH, F. J.
Second Row Molecular Orbital Calculations. 5. A Minimal Basis Indo for Na-Cl,
W83-03613 1B

MARTENS, C. S.
Sources and Fates of Sedimentary Organic Matter in the White Oak and Neuse River Estuaries,
W83-03590 5B

MARTIN, G.
Toxicity of Organolead Compounds: Study of Bacterial Inactivation by Measurement of ATP (Approche De La Toxicite Des Organo Plombs Etude De L'Inactivation Bacterienne Par Mesures D'ATP),
W83-03510 5C

MASSCHELEIN, W. J.
The Elimination of Mineral Micropollutants,
W83-03556 5D

MATSON, E. A.
Biogeochemistry of the Sediments of the Pamlico and Neuse River Estuaries, North Carolina,
W83-03620 2L

MATSUMOTO, J.
Oxidation of Ferrous Iron by Acidophilic Iron-Oxidizing Bacteria From a Stream Receiving Acid Mine Drainage,
W83-03541 5B

MATSUMOTO, M. R.
Filtration of Primary Effluent,
W83-03574 5D

MATSUNAGA, K.
Organically-Bound Copper in Lake and River Waters in Japan,
W83-03536 5B

MATTHEWS, J. E.
Water Quality in the Firth of Forth,
W83-03784 5D

MCARTHUR, R. E.
Institutional Framework for Conjunction Use of Surface and Groundwater in Tupelo-Lee County, Mississippi: Phase II,
W83-03721 4B

MCARTHUR, T.
Aquaculture Techniques: A Computer Simulation of an Intensive Fish Culture System (Aqua),
W83-03685 8I

MCCANN, C. E.
An Innovative Approach of Operating Rotating Biological Contactor Using Pure Oxygen,
W83-03666 5D

MCCREARY, J. J.
The Reactions of Chlorine Disinfectant With Organics Adsorbed on Granular Activated Carbon,
W83-03624 5F

MCCREARY, S.
Legal and Institutional Constraints and Opportunities in Wetlands Enhancement,
W83-03692 6E

MCDONALD, W.
The Feasibility of Engineering-Economic-Management Alternatives for Meeting Water Demands in Tupelo-Lee County, Mississippi,
W83-03722 6D

MCDOWELL, C. S.
Discussion of: Effect of a Bacterial Culture Product on Biological Kinetics,
W83-03571 5D

MCELIGOT, D. M.
Estimating Mixing in Aquifers by Temperature Distribution,
W83-03605 2F

MCLAUGHLIN, M. J.
A Review of the Use of Dyes as Soil Water Tracers,
W83-03736 2G

MCLOUGHLIN, A. J.
The Adsorption of Bovine Serum Albumin by Activated Sludge,
W83-03533 5D

MCNAIR, J. A.
Aquaculture Techniques: A Computer Simulation of an Intensive Fish Culture System (Aqua),
W83-03685 8I

MCQUEENEY, W. E.
Managing the Risk and Liability of Toxic Contamination of Water Supply,
W83-03630 6F

MEANS, S. A.
Movement of Salt and Hazardous Contaminants in Groundwater Systems,
W83-03619 5B

MEDLEY, D.
Removal Mechanisms for Toxic Priority Pollutants,
W83-03647 5D

MEJIA, L. H.
Dynamic Analysis of Earth Dams in Three Dimensions,
W83-03651 8D

MELLISH, G.
How Much Preventive Maintenance is too Much,
W83-03638 5D

MELMED, L. N.
The Suitability of M-Endo-LES Agar for Total Coliform Counts by Membrane Filtration,
W83-03762 5A

MERCER, J. W.
Management Model for Power Production From a Geothermal Field: 1. Hot Water Reservoir and Power Plant Model,
W83-03761 8A

MICHLER, G.
Development and Construction of a Stationary Measuring System for Limnological Observations on the Ammersee (Entwicklung Und Bau Eines Stationaren Messsystems Fur Limnologische Beobachtungen Auf Dem Ammersee),
W83-03527 7B

MIDDLEBROOKS, E. J.
Discussion of: Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds and Nitrogen Dynamics in Waste Stabilization Ponds,
W83-03573 5D

MIESCIER, J. J.
Enterococci and Other Microbial Indicators in Municipal Wastewater Effluents,
W83-03551 5A

MIKKELSEN, P. E.
Discussion: Piezometers in Earth Dam Impervious Sections,
W83-03643 8G

MILLER, K. J.
Total Water Management--The Denver Story,
W83-03746 5D

MILLER, M. C.
Macroinvertebrate Colonization of Multiplate Samplers in the Ohio River: The Effect of Dams,
W83-03824 6G

MILLER, M. H.
Agriculture and Water Quality in the Canadian Great Lakes Basin: III. Phosphorus,
W83-03841 5B

MILLER, S. B.
A Dynamic Model of the High-Rate Algal-Bacterial Wastewater Treatment Pond,
W83-03534 5D

MIRONENKO, V. A.
Numerical Modeling of Groundwater Flow Processes,
W83-03771 2F

MITCHELL, D. T.
Disposal of Household Wastewater in Soils of High Stone Content,
W83-03679 5D

MITCHELL, J. K.
Dredged Sediment for Agriculture: Lake Paradise, Mattoon, Illinois,
W83-03558 3F

MITSCH, B. F.
A Study of Radium-226 and Radon-222 Concentration in Ground Water Near a Phosphate Mining and Manufacturing Facility with Emphasis on the Hydrogeologic Characteristics of the Area,
W83-03714 5B

MODESITT, D. E.
The Use of Field Crop Residues for Sand Filter Modification of Small Community Wastewater Stabilization Ponds to Meet Secondary Treatment Requirements and Recovery of Plant Nutrient Resources,
W83-03665 5D

MOHANTY, U. C.
On the Role of Large Scale Energetics in the Onset and Maintenance of Summer Monsoon--II: Moisture Budget,
W83-03786 2B

MOLDEN, D. J.
Artificial Groundwater Recharge, San Luis Valley, Colorado,
W83-03562 4B

MONCUR, J. E. T.
Efficient Pricing and Financing of Urban Water: The Role of Development Charges,
W83-03689 6C

MONTEITH, H. D.
Assessment of Heavy Metals and PCBs at Sludge Application Sites,
W83-03633 5E

MONTGOMERY, H. A. C.
Use of Ferruginous Groundwaters to Augment Streamflow,
W83-03577 5G

MORIN, M.
Survey of Trihalomethane Levels in Rhone-Alps Water Supplies. Estimates on the Formation of Chloroform in Wastewater Treatment Plants and Swimming Pools,
W83-03540 5B

MOTE, C. R.
Disposal of Household Wastewater in Soils of High Stone Content,
W83-03679 5D

MOUTONNET, P.
Heavy Water Tracing of Soil-Water Transfers Under Irrigation,
W83-03755 2G

MOZLEY, S. C.
The Freshwater Asian Clam (Corbicula Fluminea) as a Factor Affecting Nutrient Cycling in the Chowan River, N.C.,
W83-03588 5B

MULLER, H-D.
Water pollution Due to Industrial Trout Production in Fish Farms (Gewasserbelastung Durch Industriemassige Forellenproduktion in Rinnenanlagen),
W83-03520 5B

MURABAYASHI, E. T.
Water Resources Bibliography of Hawaii,
W83-03730 10C

MURABYASHI, E. T.
Stream-Water Storage in the Ocean Using an Impermeable Membrane,
W83-03772 3B

MURASHKO, M. G.
Calculations of Seepage Losses of Water Bodies Under the Effect of Infiltration Intakes,
W83-03757 2F

MUSEN, H. L.
Soybean Responses to Irrigation and Tillage on a Compacted Coastal Plains Soil,
W83-03774 2I

MUSLU, Y.
Dispersion in the Inclined Plane Model of Trickling Filters,
W83-03537 5D

MUSTAPHA, N.
Indices for Water Quality Assessment in Rivers: A Case Study of the Linggi River in Malaysia,
W83-03844 5A

MYA, M. S.
Strategies for Water Quality Management in the Chao Phraya River in Thailand,
W83-03845 5G

NABER, G.
The Mid-Term Extension Program for the Bodensee-Wasserversorgung (Der Mittelfristige Ausbau Der Bodensee-Wasserversorgung),
W83-03523 5F

NAGLER, B. E.
Natural Gas Proves to be Economical for Pumping Water,
W83-03715 8C

NAKAMURA, K.
Oxidation of Ferrous Iron by Acidophilic Iron-Oxidizing Bacteria From a Stream Receiving Acid Mine Drainage,
W83-03541 5B

NEGISHI, M.
Organically-Bound Copper in Lake and River Waters in Japan,
W83-03536 5B

NELSON, R. D.
Seasonal Losses of N sub 2, H sub 2S and CH sub 4 from Sediments to the Atmosphere from Wetlands in the Arrowwood National Wildlife Refuge, North Dakota,
W83-03719 5A

NESTLER, W.
On the Methodology of Design and Use of Monitoring and Control Programs for Groundwater Management Facilities (Zur Methodik Des Aufbaus Und Der Nutzung Von Kontroll- Und Steuerungsprogrammen Von Grundwasserfassungsanlagen),
W83-03522 5F

NG, T. L.
The Biodegradation of N-Methyl-2-Pyrrolidone in Water by Sewage Bacteria,
W83-03538 5D

NICHOLS, V.
Removal Mechanisms for Toxic Priority Pollutants,
W83-03647 5D

NOIKE, T.
Oxidation of Ferrous Iron by Acidophilic Iron-Oxidizing Bacteria From a Stream Receiving Acid Mine Drainage,
W83-03541 5B

NOORDSIJ, A.
Methodology of Research Concerning Micropollutants: Biological Tests,
W83-03554 5A

NORDLIE, K. J.
Acidification Effects on Macroinvertebrates and Fathead Minnows (Pimephales Promelas) in Outdoor Experimental Channels,
W83-03532 5C

NOUTSOPOULOS, G. C.
Discussion: Boundary Shear in Smooth and Rough Channels,
W83-03652 8B

O'BRIEN, J. E.
2,3,7,8-Tetrachlorodibenzo-p-Dioxin in Sediment Samples From Love Canal Storm Sewers and Creeks,
W83-03814 5A

O'KEEFE, P. W.
2,3,7,8-Tetrachlorodibenzo-p-Dioxin in Sediment Samples From Love Canal Storm Sewers and Creeks,
W83-03814 5A

O'NEAL, S. W.
Integration of Management Methods with the Life Cycle and Ecology of the Filamentous Alga, Pithophora,
W83-03680 4A

ONUF, C.
Restoration Techniques, Research, and Monitoring: Vegetation,
W83-03694 2L

ONYSKOW, L. P.
Hydrologic Evaluation of Small Impoundments in Arid and Semiarid Regions,
W83-03667 6G

OVERCAMP, T. J.
Solubilization Rate of Atmospheric Particulate Matter and Impact on Water Quality,
W83-03677 5B

PAERL, HANS W.
Factors Regulating Nuisance Blue-Green Algal Bloom Potentials in the Lower Neuse River, N.C.,
W83-03566 5C

PAETZOLD, R. F.
Field Vs. Laboratory Determined Hydraulic Conductivities of Some Slowly Permeable Horizons,
W83-03781 2G

PALIN, A. T.
New Correction Procedures for Chromate Interference in the DPD Method for Residual Free and Combined Chlorine in Water,
W83-03579 5A

PAMPERL, M. A.
Diatoms of Lake of the Ozarks, Missouri,
W83-03723 2H

PANDIT, A.
A Finite Element Model to Predict the Flow of Underground Contaminants Due to Leakage of Chemical and/or Radioactive Material From a Buried Containment,
W83-03672 5B

PATHACK, B. M. R.
An Analysis of Mauritian Winter Rainfall,
W83-03787 2B

PEARCE, R.
Nutrient and Multi-Species Criteria Standard for the Chowan River, North Carolina,
W83-03623 5C

PELLENBARG, R. E.
Silicones in Chesapeake Bay Sediments,
W83-03804 5B

PERRY, R.
Removal of Nitrilotriacetic Acid During Primary Sedimentation and Its Effect on Metal Removal,
W83-03813 5D

PETERKA, J. J.
Seasonal Losses of N sub 2, H sub 2S and CH sub 4 from Sediments to the Atmosphere from Wetlands in the Arrowwood National Wildlife Refuge, North Dakota,
W83-03719 5A

PETERSON-HOLM, N.
Silica in Lakes: Nutrient Competition, Equilibrium Reactions in Sediment Pore Waters, and Role in Metal Cycling,
W83-03699 2H

PHAMWON, S.
A River Basin Network Model for Conjunctive Use of Surface and Groundwater: Program CONSIM,
W83-03596 6A

PHILLIPS, R. E.
Predicting Infiltration and Surface Runoff from Reconstructed Spoils and Soils,
W83-03610 4C

PINEAU, M.
Mathematical Model for Management of Water Quality in Rivers: Application to the Yamaska River (Modele Mathematique De Gestion De La Qualite De L'Eau En Riviere: Application a La Riviere Yamaska),
W83-03839 5G

PIRT, J.
A Study of Low Flows Using Data From the Severn and Trent Catchments. Part II: Flow Frequency Procedures,
W83-03656 2E

PLACEK, T. D.
Phase and Compression Behavior in Sedimentation and Thickening of Liquid-Solid Suspensions,
W83-03727 5D

POELS, C. L. M.
Methodology of Research Concerning Micropollutants: Biological Tests,
W83-03554 5A

POLLOCK, R.
Efficient Pricing and Financing of Urban Water: The Role of Development Charges,
W83-03689 6C

PORTER, W. C.
Growth, Development, and Root Quality of Sweet Potato as Influenced by Soil Warming,
W83-03615 3C

POULIN, M.
A Method To Compute River Heating - Application to the Management of Thermal Loadings to the Rhine River (Une Methode De Calcul De L'Echauffement Des Rivieres - Application a La Gestion Des Rejets Themiques Au Rhin),
W83-03584 5G

PRASAD, K.
Hydrometeorological Study of Severe Rainstorms of North Bihar,
W83-03788 2B

PRASAD, S. N.
Routing Graded Sediments in Streams: Applications,
W83-03832 2J

Routing Graded Sediments in Streams: Formulations,
W83-03833 2J

PRATT, A. J.
Evaporative Cooling by Mist and Sprinkle Irrigation and Conserving Water in Vegetable Irrigation in Arizona,
W83-03729 3F

PREST, J.
Sources of Trihalomethanes and Other C1 and C2 Halo-Organics in Potable Water,
W83-03799 5F

PRUTTON, D. R.
Administrative Coordination in the Implementation of Agricultural Nonpoint Pollution Controls,
W83-03559 6E

PUCCI, A. E.
Cu, Cd and Zn in Blanca Bay Surface Sediments, Argentina,
W83-03802 5B

QUENTIN, K-E.
Hydrogeochemical Investigations with Regard to the Origin of Heavy Metals in Groundwater (Hydrogeochemische Untersuchungen Zur Herkunft Von Schwermetallen Im Grundwasser),
W83-03511 2K

QUISENBERRY, V. L.
Soybean Responses to Irrigation and Tillage on a Compacted Coastal Plains Soil,
W83-03774 2I

RACAULT, Y.
Tests on Aerators: Conclusions Drawn From 500 Clean Water Tests Conducted in 200 Different Sewage Treatment Plants - I Test Procedure (Essais D'Aerateurs Enseignements Tires De 500 Essais En Eu Clair Effectues Dans 200 Stations D'Epuration Differentes - I Methodologie),
W83-03535 5D

RADECKI, A.
Isolation, Identification, and Determination of Polycyclic Aromatic Hydrocarbons in Sewage,
W83-03794 5A

RANDAZZO, A. F.
Mineralogical Model of the Floridan Aquifer in the Southwest Florida Water Management District,
W83-03670 2F

RASMUSSEN, W. O.
Simulation of Nutrient, Microorganism, and Heavy Metal Transport Capacity of Suspended Sediment,
W83-03732 2J

READ, P. A.
Water Quality in the Firth of Forth,
W83-03784 5D

REAM, R.
Industrial Wastewater Pretreatment Standards--A Local Approach,
W83-03765 6F

REES, J. F.
Landfill Management and Leachate Quality,
W83-03812 5E

REGNIER, B.
The Elimination of Mineral Micropollutants,
W83-03556 5D

RENDALL, J. D.
Caco3 Neutralization of Acidified Surface Waters,
W83-03834 5G

RENTON, J. J.
Evaluation of Acid-Mine-Water Generation and Acid-Mine-Drainage Potential of Coal and Coal-Associated Rocks,
W83-03820 5B

REWKOWSKA, G.
Isolation, Identification, and Determination of Polycyclic Aromatic Hydrocarbons in Sewage,
W83-03794 5A

RICCI, E. D.
Factors Influencing Dieldrin and DDT Residues in Carp from the Des Moines River, Iowa, 1977-80,
W83-03743 5B

RICHARDT, P.
Preferred Solutions and Development Trends for Wastewater Conveyance in Drainage Networks (Vorzugslosungen Und Entwicklungstendenzen Der Abwasserforderung in Entwasserungsnetzen),
W83-03517 5D

RILEY, M. B.
1,2-Dibromo-3-Chloropropane Residues in Water in South Carolina, 1970-80,
W83-03744 5B

RINGUELET, R.
Pollution of the Mediterranean Coastal Area (La Pollution Du Littoral De La Mediterranee),
W83-03509 5D

RIV'YER, I. K.
Vertical Distribution of Zooplankton in the Mologa River in Winter,
W83-03815 2H

RIVERA, J. R.
The Reactions of Chlorine Disinfectant With Organics Adsorbed on Granular Activated Carbon,
W83-03624 5F

ROBERTSON, T. M.
A 'Micro-Lysimter' Method for Determining Evaporation From Bare Soil: Description and Laboratory Evaluation,
W83-03783 2D

ROBIN, M. J. L.
Hydrodynamic Dispersion Involving Cationic Adsorption During Unsaturated, Transient Water Flow in Soil,
W83-03749 2G

ROBINSON, J. B.
Agriculture and Water Quality in the Canadian Great Lakes Basin: III. Phosphorus,
W83-03841 5B

ROBINSON, P. J.
Variations in Monthly Precipitation Over North Carolina,
W83-03598 7C

RODRIGUEZ, S. A.
Hydraulics of Solving Unsteady Debris Flows,
W83-03608 8B

ROHDE, E.
Results of Lake Cleanup in the Order-Havel Catchment Areas (Ergebnisse Der Seesanierung Aus Dem Einzugsgebiet Der Wwd Order-Havel),
W83-03516 5G

ROHNER, M.
Performance Improvement with Broad-Crowned Spillways (Leistungssteigerung Breitkroniger Uberfalle),
W83-03518 8A

ROSS, D. S.
Filtration of Primary Effluent,
W83-03574 5D

ROSSIN, A. C.
Removal of Nitrilotriacetic Acid During Primary Sedimentation and Its Effect on Metal Removal,
W83-03813 5D

ROSSMILLER, R. L.
Technology Transfer Program: Urban Stormwater Management Implementation in Iowa,
W83-03696 4A

ROYER, J. P.
State Options for Nonstructural Flood Risk Management,
W83-03702 6F

RUBIN, H.
Movement of Salt and Hazardous Contaminants in Groundwater Systems,
W83-03619 5B

RUSHTON, K. R.
An Improved Understanding of Flow in a Limestone Aquifer Using Field Evidence and Mathematical Models,
W83-03578 2F

RUSSELL, C. S.
Economic Research Needs Relevant to Improved Drinking Water Quality,
W83-03637 6B

RUTLEDGE, E. M.
Disposal of Household Wastewater in Soils of High Stone Content,
W83-03679 5D

SACKINGER, C. T.
RO vs. MSF for High-Capacity Seawater Desalination Plants,
W83-03622 3A

SAGE, A. L. III
Legal Analysis of the Lee County Water Supply Problem,
W83-03720 6E

SALEEMI, A. R.
Recent Developments on Stochastic Programming Model for Water Quality Management,
W83-03846 5G

SALES, A.
Preliminary Evaluation of the Pretreatment of Fuel Alcohol Fermentation Stillage Through an Anaerobic Filter,
W83-03664 5D

SALKER, D. G.
A Question of Sampling,
W83-03595 7B

SAMMIS, T. W.
Water-Use Production Functions of Selected Agronomic Crops in Northwestern New Mexico, Phase II,
W83-03560 2D

SANDERS, D. C.
Growth, Development, and Root Quality of Sweet Potato as Influenced by Soil Warming,
W83-03615 3C

SANDERS, T. G.
Representative Sampling Location Criterion for Rivers,
W83-03740 5A

SANDERS, W.
Water Conservation in Residential Development: Land-Use Techniques,
W83-03716 3D

SAPOZHNIKOV, V. V.
Hydrochemical Methods of Investigating Production and Destruction Processes in Natural Waters,
W83-03756 2H

SARALOV, A. I.
Vertical Distribution of Zooplankton in the Mologa River in Winter,
W83-03815 2H

SARKER, R. P.
Probabiliity Analysis of Short Period Rainfall in Dry Farming Tract in India,
W83-03800 2B

SARRO, F.
Heavy Metal Distribution in Sediments from the Gulf of Catania (Italy),
W83-03803 5B

SCHADLER, B.
Automatic Determination of Snow Cover (Schneedecke Automatisch Erfasst),
W83-03529 7B

SCHAFRAN, G. C.
Caco3 Neutralization of Acidified Surface Waters,
W83-03834 5G

SCHALSCHA, B. E.
The Nitrogen Balance of Vegetable Crops Irrigated with Untreated Effluent,
W83-03745 5B

SCHAUFELBERGER, W.
The Weinzodl Power Plant on the Mur (Das Murkraftwerk Weinzodl),
W83-03526 8A

SCHEIRER, D. M.
Growth, Development, and Root Quality of Sweet Potato as Influenced by Soil Warming,
W83-03615 3C

SCHELL, D. M.
Trophic Energetics in Arctic Freshwater Ecosystems,
W83-03621 2L

SCHMIDT, H.
Results of Lake Cleanup in the Order-Havel Catchment Areas (Ergebnisse Der Seesanierung Aus Dem Einzugsgebiet Der Wwd Order-Havel),
W83-03516 5G

SCHRIMPFF, E.
Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria/F. R. G. 1. Simple Methods for Calculating 'Acidic Aggressiveness' and Carbonate Dissolution Tendency (Kalk-Kohlensaure-Gleicgewicht in Oberflachennahen Grundwassern Nordostbayerns I. Einfache Gleichgewichtsberechnungen Zur 'Saureaggfressivitat' Und Kalklosungstendenz),
W83-03512 2K

Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria. II. Spatial and Temporal Variances (Kalk -Kohlensaure Gleichgewicht in Oberflachennahen Grundwassern Nordostbayerns. II. Zur Hydrochemischen Raumlichen Und Zeitlichen Varianz),
W83-03514 2K

SCHUCHARD, K. M.
The Fate, Distribution and Limnological Effects of Volcanic Tephra in the St. Joe and Coeur D'Alene River Deltas of Lake Coeur D'Alene, Idaho,
W83-03597 5B

SCHUK, W. W.
Evaluation of a Dissolved Oxygen Field Test Protocol,
W83-03631 7B

SCHULZ, F.
Studies on the Soil Application Treatment of Coking Plant Wastewater (Untersuchungen Zur Bodenbehandlung Von Kokereiabwasser),
W83-03519 5D

SCHWINDT, F. J.
Effect of Seepage from Unlined Municipal Waste Stabilization Lagoons on Chemical Quality of Groundwater in Shallow Aquifers,
W83-03731 5B

SCOTT, H. D.
Disposal of Household Wastewater in Soils of High Stone Content,
W83-03679 5D

A Survey of Soils Irrigated With Arkansas River Water,
W83-03589 3C

SCOTTER, D. R.
Constant-Flux Infiltration From a Hemispherical Cavity,
W83-03782 2G

SCOTTRON, V. E.
River Management Research Needs,
W83-03601 6B

SEED, H. B.
Dynamic Analysis of Earth Dams in Three Dimensions,
W83-03651 8D

SEN, A. K.
Agro-Ecological Regions of Western Rajasthan,
W83-03850 2A

SERICANO, J. L.
Cu, Cd and Zn in Blanca Bay Surface Sediments, Argentina,
W83-03802 5B

SETTINE, R. L.
Sampling and Analysis of Industrial Benthic Polynuclear Aromatic Hydrocarbons in Industrialized Urban Watersheds,
W83-03726 5A

SHAFER, M.
Silica in Lakes: Nutrient Competition, Equilibrium Reactions in Sediment Pore Waters, and Role in Metal Cycling,
W83-03699 2H

SHAIKH, A. U.
A Systematic Study to Reduce Trihalomethane Precursors in Little Rock Drinking Water by Combined Alum Coagulation/Powdered Activated Carbon Treatment,
W83-03683 5F

SHARMA, K. D.
A Severe Flood in Luni Basin, Western Rajasthan During July 1979--A Case Study,
W83-03808 2E

SHAWCROSS, J. F.
Increasing Rockport's Water Supply,
W83-03662 6D

SHERARD, J. L.
Discussion: Piezometers in Earth Dam Impervious Sections,
W83-03643 8G

SHERRARD, J. H.
Measurement and Validity of Oxygen Uptake as an Activated Sludge Process Control Parameter,
W83-03569 5D

SHIBER, J. G.
Plastic Pellets on Spain's 'Costa Del Sol' Beaches,
W83-03785 5B

SHIMP, G. F.
Development of a Regional Sludge Dewatering Facility Using Pressure Filters,
W83-03661 5E

SHUBERT, L. E.
Fate of Herbicides in Groundwater and Surface Runoff and Their Biotic Effects on Prairie Potholes,
W83-03682 5B

SILVERMAN, A. J.
A Preliminary Investigation Into the Use of Crayfish as a Sensitive Species to Pollutants in the Clark Fork River Near Missoula, MT,
W83-03617 5B

SIMPSON, C. M.
A Study of Low Flows Using Data From the Severn and Trent Catchments. Part II: Flow Frequency Procedures,
W83-03656 2E

SIMPSON, E. S.
Estimating Mixing in Aquifers by Temperature Distribution,
W83-03605 2F

SINATRA, F.
Heavy Metal Distribution in Sediments from the Gulf of Catania (Italy),
W83-03803 5B

SINGH, G.
A Severe Flood in Luni Basin, Western Rajasthan During July 1979--A Case Study,
W83-03808 2E

SINHA, P. C.
On the Role of Large Scale Energetics in the Onset and Maintenance of Summer Monsoon--II: Moisture Budget,
W83-03786 2B

SKAGGS, R. W.
Growth, Development, and Root Quality of Sweet Potato as Influenced by Soil Warming,
W83-03615 3C

SKAU, C. M.
Relationships Among Precipitation, Snowmelt, Subsurface Flow, Groundwater Recharge, and Streamflow Generation in the Clear Creek Watershed, Eastern Sierra Nevada,
W83-03822 2A

SKILLE, J. M.
The Fate, Distribution and Limnological Effects of Volcanic Tephra in the St. Joe and Coeur D'Alene River Deltas of Lake Coeur D'Alene, Idaho,
W83-03597 5B

SLADECKOVA, A.
Biological Problems in Cooling Water Circulation (Biologische Probleme im Kuhlwasserkreislauf),
W83-03528 5B

SMITH, D. W.
Innovative Approaches to Sewage Collection, Treatment, and Disposal: Practices in Northern Canada,
W83-03840 5D

SMITH, E. J.
An Improved Understanding of Flow in a Limestone Aquifer Using Field Evidence and Mathematical Models,
W83-03578 2F

SMITH, M.
Movement of Bacteria Through Macropores to Ground Water,
W83-03705 5B

SMITH, R. M.
2,3,7,8-Tetrachlorodibenzo-p-Dioxin in Sediment Samples From Love Canal Storm Sewers and Creeks,
W83-03814 5A

SMITH, S. R.
Investigation of Polycyclic Aromatic Hydrocarbons in Water Systems,
W83-03591 5A

SOMERS, F. G.
An Evaluation of Seashore Mallow, Kosteletzkya Virginica (L.) Presl., as a Potential New Crop Which Can Be Grown in Brackish Water,
W83-03618 3C

SORENSEN, J.
Towards an Overall Strategy in Designing Wetland Restorations,
W83-03695 4D

SPANGLER, L. E.
Studies in Dye-Tracing Techniques and Karst Hydrogeology,
W83-03599 5B

SPENCER, D. F.
Integration of Management Methods with the Life Cycle and Ecology of the Filamentous Alga, Pithophora,
W83-03680 4A

SPIRES, A. C.
Agriculture and Water Quality in the Canadian Great Lakes Basin: III. Phosphorus,
W83-03841 5B

STANDEN, D. A.
Acidification Effects on Macroinvertebrates and Fathead Minnows (Pimephales Promelas) in Outdoor Experimental Channels,
W83-03532 5C

STARK, J. C.
A Modified Line Source Sprinkler Technique for Continuous-Variable Leaching Studies,
W83-03767 3F

STEELE, K. F.
Chemistry of the Springs of the Ozark Mountains, Northwestern Arkansas,
W83-03707 2K

STEENHUIS, T. S.
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

STEIN, T.
The Biodegradation of BIS (Tributyltin) Oxide (TBTO) by Bilogical Sewage Treatment (Der Biologische Abbau Von Tributylzinnoxid (TBTO) in Einer Belebtschlammanlage),
W83-03506 5D

STEKETEE, C. H.
Building Sewer Renovation--A Key to Successful I/I Control,
W83-03747 5D

STEYER, D.
Studies on the Soil Application Treatment of Coking Plant Wastewater (Untersuchungen Zur Bodenbehandlung Von Kokereiabwasser),
W83-03519 5D

STIFTEL, B.
Making Waves: Public Participation in State Water Planning,
W83-03614 6F

STOEVENER, H. H.
Water Rights Transfers: A Legal, Economic, and Informational Analysis of Water in Oregon,
W83-03594 6E

STONE, K. L.
Kinetics of Phosphorus Uptake in the Chowan River, North Carolina,
W83-03711 5B

STONES, T.
Removal of Phosphates,
W83-03791 5D

STOVER, E. L.
Biological Treatability of Specific Organic Compounds Found in Chemical Industry Wastewaters,
W83-03550 5D

Removal Mechanisms for Toxic Priority Pollutants,
W83-03647 5D

SULLIVAN, J. F.
Impact of Snowmelt-Runoff from Agricultural Watersheds on Dissolved Oxygen,
W83-03636 5B

SULLIVAN, S. B.
Studies in Dye-Tracing Techniques and Karst Hydrogeology,
W83-03599 5B

SUNADA, D. K.
Artificial Groundwater Recharge, San Luis Valley, Colorado,
W83-03562 4B

SWANBACK, S. G.
The Use of Field Crop Residues for Sand Filter Modification of Small Community Wastewater Stabilization Ponds to Meet Secondary Treatment Requirements and Recovery of Plant Nutrient Resources,
W83-03665 5D

TALBOT, R. W.
Effects of Acid Deposition (Rain) on a Piedmont Aquatic Ecosystem: Acid Inputs, Neutralization, and pH Changes,
W83-03700 5C

TANAKA, J.
Investigation of Polycyclic Aromatic Hydrocarbons in Water Systems,
W83-03591 5A

TATE, C. H.
The Interior Surface of Galvanized Steel Pipe: A Potential Factor in Corrosion Resistance,
W83-03650 8G

TAVEAU, M.
Survey of Trihalomethane Levels in Rhone-Alps Water Supplies. Estimates on the Formation of Chloroform in Wastewater Treatment Plants and Swimming Pools,
W83-03540 5B

TAYLOR, C. J.
Studies in Dye-Tracing Techniques and Karst Hydrogeology,
W83-03599 5B

TCHOBANOGLOUS, G.
Filtration of Primary Effluent,
W83-03574 5D

TECLAFF, L. A.
Principles for Transboundary Groundwater Pollution Control,
W83-03501 5G

THOMAS, A. R.
Discussion: Flow Resistance in Coarse Gravel Bed Rivers,
W83-03644 8B

THOMAS, G. W.
Movement of Bacteria Through Macropores to Ground Water,
W83-03705 5B

THOMPSON, J. E.
Micropollutants Produced by Disinfection of Wastewater Effluents,
W83-03546 5D

THORNE, C.
Direct Measurements of Secondary Currents in Natural Meander (Direktmessung Von Sekundarstromungen In Natuerlichen Maandern),
W83-03525 2E

THRAILKILL, J.
Studies in Dye-Tracing Techniques and Karst Hydrogeology,
W83-03599 5B

THUROW, C.
Water Conservation in Residential Development: Land-Use Techniques,
W83-03716 3D

TIPPETS, R.
Industrial Wastewater Pretreatment Standards--A Local Approach,
W83-03765 6F

TIRSCH, F. S.
River Basin Water Quality Monitoring Network Design,
W83-03593 5A

TOMLINSON, L. M.
An Improved Understanding of Flow in a Limestone Aquifer Using Field Evidence and Mathematical Models,
W83-03578 2F

TOOKOS, I.
Pilot Plant Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W83-03792 5D

TOPP, G. C.
Electromagnetic Determination of Soil Water Content Using TDR: I. Applications to Wetting Fronts and Steep Gradients,
W83-03766 7B

Electromagnetic Determination of Soil Water Content Using TDR: II. Evaluation of Installation and Configuration of Parallel Transmission Lines,
W83-03806 7B

TRICARD, D.
Sanitary Monitoring of Seawater in Bathing Areas of France (Surveillance Sanitaire Des Eaux De Baignade En Mer En France),
W83-03515 5G

TRUSCHEL, A. D.
A Parametric Model for Peak Flow Prediction in Ungaged Ephemeral Watersheds,
W83-03778 2A

TSAI, C. F.
Instream Flow Requirements for Fish and Fisheries in Maryland,
W83-03776 2E

TSANG, C. F.
Injection and Thermal Breakthrough in Fractured Geothermal Reservoirs,
W83-03585 2F

TUTTLE, M. E.
Novel Composite Membranes,
W83-03678 3A

TYAGI, A. K.
Impact of Artificial Recharge on Groundwater Quality of Gypsum Aquifer in Harmon County, Oklahoma,
W83-03607 5B

UCHTMANN, D. L.
Administrative Coordination in the Implementation of Agricultural Nonpoint Pollution Controls,
W83-03559 6E

UDLUFT, P.
Hydrogeochemical Investigations with Regard to the Origin of Heavy Metals in Groundwater (Hydrogeochemische Untersuchungen Zur Herkunft Von Schwermetallen Im Grundwasser),
W83-03511 2K

UNGER, P. W.
Surface Soil Physical Properties After 36 Years of Cropping to Winter Wheat,
W83-03805 2J

URISH, D. W.
Analysis of Critical Water Problems in the Northeastern United States to Determine Essential Research Requirements,
W83-03592 6B

VAIDYA, R.
Stated Financing Policies of Government Agencies and the Experience of Rural Water Supply Systems,
W83-03606 6A

VAN DER GAAG, M. A.
Methodology of Research Concerning Micropollutants: Biological Tests,
W83-03554 5A

VANGANI, N. S.
A Severe Flood in Luni Basin, Western Rajasthan During July 1979--A Case Study,
W83-03808 2E

VAVILIN, V. A.
Comparative Evaluation of Mathematical Models Used for Calculating Biological Filters,
W83-03735 5D

VERGARA, F. I.
The Nitrogen Balance of Vegetable Crops Irrigated with Untreated Effluent,
W83-03745 5B

VIAL, J.
Survey of Trihalomethane Levels in Rhone-Alps Water Supplies. Estimates on the Formation of Chloroform in Wastewater Treatment Plants and Swimming Pools,
W83-03540 5B

VILLENEUVE, J. P.
Mathematical Model for Management of Water Quality in Rivers: Application to the Yamaska River (Modele Mathematique De Gestion De La Qualite De L'Eau En Riviere: Application a La Riviere Yamaska),
W83-03839 5G

VINCENT, C. L.
Factors Controlling Phytoplankton in Lake Vanda (77 Degrees S),
W83-03838 2H

VINCENT, W. F.
Factors Controlling Phytoplankton in Lake Vanda (77 Degrees S),
W83-03838 2H

VIVIERS, J. M. P.
Harvesting of Algae Grown on Raw Sewage,
W83-03737 5D

VOMOCIL, J. A.
Perched Water Tables on Hillsides in Western Oregon: I. Some Factors Affecting Their Development and Longevity,
W83-03768 2G

Perched Water Tables on Hillsides in Western Oregon: II. Preferential Downslope Movement of Water and Anions,
W83-03751 2G

WACHS, A. M.
Magnesium Recycling by Carbonation and Centrifugation of High-Lime Wastewater Sludge,
W83-03660 5E

WACHS, B.
Concentration of Heavy Metals in Fishes from the River Danube (Schwermetallgehalt von Fischen aus der Donau),
W83-03504 5C

WADE, J. C.
Water and Energy Conservation in Irrigated Agriculture: An Arid Area Technological and Economic Case Study,
W83-03773 3F

WAGNER, R.
Investigation of the Solidification of Wastewater Concentrates with Inorganic Binding Agents (Untersuchungen Uber die Verfestigung von Abwasserkonzentraten mit Anorganischen Bindemitteln),
W83-03505 5E

WALSKI, T. M.
Using Water Distribution System Models,
W83-03641 8B

WANG, L. K.
Compact Nitrogen Removal Options for Lake Como,
W83-03793 5D

WANG, W. M.
Preliminary Evaluation of the Pretreatment of Fuel Alcohol Fermentation Stillage Through an Anaerobic Filter,
W83-03664 5D

WARD, A. D.
Predicting Infiltration and Surface Runoff from Reconstructed Spoils and Soils,
W83-03610 4C

WARNER, J. W.
Artificial Groundwater Recharge, San Luis Valley, Colorado,
W83-03562 4B

WARRICK, A. W.
Trickle Irrigation - Modeling Water and Solutes,
W83-03777 2G

WATLING, H. R.
Metal Surveys in South African Estuaries V. Kromme and Gamtoos River (St. Francis Bay),
W83-03738 5B

Metal Surveys in South African Estuaries VI. Sundays River,
W83-03739 5B

WATLING, R. J.
Metal Surveys in South African Estuaries V. Kromme and Gamtoos River (St. Francis Bay),
W83-03738 5B

Metal Surveys in South African Estuaries VI. Sundays River,
W83-03739 5B

WATSON, P. G.
Water Quality in the Firth of Forth,
W83-03784 5D

WATTS, F. C.
Field Vs. Laboratory Determined Hydraulic Conductivities of Some Slowly Permeable Horizons,
W83-03781 2G

WEBBER, M. D.
Assessment of Heavy Metals and PCBs at Sludge Application Sites,
W83-03633 5E

WEEKS, K. G.
Conservation Aspects of Two River Improvement Schemes in the River Thames Catchment,
W83-03646 4A

WEILAND, R. H.
Column Design for Recovery of NH3 and CO2 from Wastewater in a Urea Plant,
W83-03748 5D

WELLER, W. A. JR.
Factors Affecting Stress Cell Measurements in Soil,
W83-03657 8D

WELLS, L. G.
Predicting Infiltration and Surface Runoff from Reconstructed Spoils and Soils,
W83-03610 4C

WESCHE, T. A.
The Snowy Range Observatory: Climatological and Streamflow Data Report 1982,
W83-03675 7C

WEST, J. W.
The History of Waste Detection in Severn-Trent Water Authority's Derwent Division,
W83-03654 5F

WHITE, J. R.
Caco3 Neutralization of Acidified Surface Waters,
W83-03834 5G

WHITE, R. E.
Movement of Bacteria Through Macropores to Ground Water,
W83-03705 5B

WHITTAKER, G. W.
Water Rights Transfers: A Legal, Economic, and Informational Analysis of Water in Oregon,
W83-03594 6E

WILEY, M. L.
Instream Flow Requirements for Fish and Fisheries in Maryland,
W83-03776 2E

WILSON, T. M.
Ground Water Yields and Availability in Fractured Crystalline Rocks, Wake County, North Carolina,
W83-03733 2F

WIRTH, P. K.
Activated Carbon for Treatment of Cadmium Wastewater,
W83-03825 5D

WITHERSPOON, A. M.
Nutrient and Multi-Species Criteria Standard for the Chowan River, North Carolina,
W83-03623 5C

WONG, B.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W83-03580 6A

WOZNIAK, D. J.
Variables Affecting Metal Removal from Sludge,
W83-03581 5E

WRIGHT, W. R.
Land Application of Sewage Sludge Landfill Leachate,
W83-03563 5E

WURTSBAUGH, W. A.
Effect of Copper on Nitrogen Fixation and Growth of Blue-Green Algae in Natural Plankton Associations,
W83-03837 5F

WUSCHANSKY, B.
Development and Construction of a Stationary Measuring System for Limnological Observations on the Ammersee (Entwicklung Und Bau Eines Stationaren Messsystems Fur Limnologische Beobachtungen Auf Dem Ammersee),
W83-03527 7B

YAMADA, R.
Stream-Water Storage in the Ocean Using an Impermeable Membrane,
W83-03772 3B

YANG, F. C.
Modelling a River Water Quality System: A Case Study of Tanshui River in Taiwan,
W83-03847 5G

YOUNG, D. W.
Hydrologic Evaluation of Small Impoundments in Arid and Semiarid Regions,
W83-03667 6G

YRJANAINEN, G.
Lake Weir Designed to Resist Ice Damage,
W83-03681 8A

ZAISS, U.
Coliphages and Coliform Bacteriain Running Waters of Different Quality (Coliphagen und Coliforme Bakterien in Fliessgewassern Unterschiedlicher Gute),
W83-03513 5A

ZEDLER, J.
Restoration Techniques, Research, and Monitoring: Vegetation,
W83-03694 2L

ZENTNER, J.
Development of Regional Wetland Restoration Goals: Coastal Wetlands,
W83-03691 6G

ZIBERT, A. A.
Simplified Mathematical Model of Unsteady Flow in Complex Channel Systems,
W83-03759 8B

ZIELINSKI, P. B.
A Study of the Occurrence of Hydrogen Sulfide in Sewers in the Piedmont Area of South Carolina,
W83-03671 8G

ZIEMANN, P.
Trophic Energetics in Arctic Freshwater Ecosystems,
W83-03621 2L

ZIKOPOULOS, J. N.
Discussion of: Effect of a Bacterial Culture Product on Biological Kinetics,
W83-03571 5D

ZISCHKE, J. A.
Acidification Effects on Macroinvertebrates and Fathead Minnows (Pimephales Promelas) in Outdoor Experimental Channels,
W83-03532 5C

ZITRIDES, T. G.
Discussion of: Effect of a Bacterial Culture Product on Biological Kinetics,
W83-03571 5D

ZITTA, V. L.
The Feasibility of Engineering-Economic-Management Alternatives for Meeting Water Demands in Tupelo-Lee County, Mississippi,
W83-03722 6D

ZLOTNIK, V. A.
Calculations of Seepage Losses of Water Bodies Under the Effect of Infiltration Intakes,
W83-03757 2F

ZOBECK, T. M.
Calculating the Depths of Soil Moisture Control Sections From Laboratory Data,
W83-03780 2G

ORGANIZATIONAL INDEX

AGRICULTURAL RESEARCH ORGANIZATION, BET-DAGAN (ISRAEL). VOLCANI CENTER.
Statistical Analysis of Crop Yield Controlled Line-Source Irrigation,
W83-03753 3F

AIR FORCE OCCUPATIONAL AND ENVIRONMENTAL HEALTH LAB., BROOKS AFB, TX.
Atmospheric Release of Chlorinated Organic Compounds from the Activated Sludge Process,
W83-03583 5D

AKADEMIA MEDYCZNA, GDANSK (POLAND). DEPT. OF PHYSICAL CHEMISTRY.
Isolation, Identification, and Determination of Polycyclic Aromatic Hydrocarbons in Sewage,
W83-03794 5A

AKADEMIYA NAUK SSSR, MOSCOW. INST. VODNYKH PROBLEM.
Comparative Evaluation of Mathematical Models Used for Calculating Biological Filters,
W83-03735 5D

AKRON UNIV., OH. DEPT. OF CIVIL ENGINEERING.
Determination of Biomass MLVSS in Pact Sludges,
W83-03570 5D

ALABAMA UNIV. IN BIRMINGHAM. DEPT. OF BIOLOGY.
Biological Treatment of Cyanide in High-Strength Coke-Plant Wastewater,
W83-03697 5D

Adaptation of an Activated Sludge Process to the Treatment of Coke-Plant Wastewater Containing High Levels of Cyanide,
W83-03710 5D

ALABAMA UNIV. IN BIRMINGHAM. DEPT. OF CHEMISTRY.
Sampling and Analysis of Industrial Benthic Polynuclear Aromatic Hydrocarbons in Industrialized Urban Watersheds,
W83-03726 5A

ALASKA UNIV., FAIRBANKS. DEPT. OF ENGINEERING.
Use of Hydrocyclones to Treat Seafood-Processing Wastewaters,
W83-03572 5D

ALASKA UNIV., FAIRBANKS. INST. OF WATER RESOURCES.
Regional Flood Frequency Analysis for Alaska,
W83-03611 2E

Trophic Energetics in Arctic Freshwater Ecosystems,
W83-03621 2L

ALBERTA UNIV., EDMONTON. DEPT. OF CIVIL ENGINEERING.
Innovative Approaches to Sewage Collection, Treatment, and Disposal: Practices in Northern Canada,
W83-03840 5D

ALL-UNION RESEARCH INST. OF MARINE FISHERIES AND OCEANOGRAPHY, MOSCOW (USSR).
Hydrochemical Methods of Investigating Production and Destruction Processes in Natural Waters,
W83-03756 2H

AMERICAN PLANNING ASSOCIATION, CHICAGO, IL.
Water Conservation in Residential Development: Land-Use Techniques,
W83-03716 3D

ARIZONA UNIV., TUCSON.
Water and Energy Conservation in Irrigated Agriculture: An Arid Area Technological and Economic Case Study,
W83-03773 3F

ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.
Estimating Mixing in Aquifers by Temperature Distribution,
W83-03605 2F

Hydrologic Evaluation of Small Impoundments in Arid and Semiarid Regions,
W83-03667 6G

Measurement, Prediction, and Hazard Evaluation of Earth Fissuring and Subsidence Due to Ground-Water Overdraft,
W83-03668 2F

Stable Isotopic Investigation of the Ground Water Quality and Transport Systems in the Safford Valley, Arizona,
W83-03674 2K

A Comparative Evaluation of Ground-Water Management Techniques,
W83-03704 4B

Management Model for Power Production From a Geothermal Field: 1. Hot Water Reservoir and Power Plant Model,
W83-03761 8A

ARIZONA UNIV., TUCSON. DEPT. OF MATHEMATICS.
Trickle Irrigation - Modeling Water and Solutes,
W83-03777 2G

ARIZONA UNIV., TUCSON. DEPT. OF PLANT SCIENCES.
Effect of Mowing Height Upon Consumptive Water Use, Groundwater Recharge and Recharge Quality from Bermudagrass Watered with Secondary Treated Effluent,
W83-03816 4B

ARIZONA UNIV., TUCSON. SCHOOL OF RENEWABLE NATURAL RESOURCES.
Simulation of Nutrient, Microorganism, and Heavy Metal Transport Capacity of Suspended Sediment,
W83-03732 2J

ARIZONA WATER RESOURCES RESEARCH CENTER, TUCSON.
Evaporative Cooling by Mist and Sprinkle Irrigation and Conserving Water in Vegetable Irrigation in Arizona,
W83-03729 3F

ARKANSAS STATE UNIV., STATE UNIVERSITY. DEPT. OF CHEMISTRY.
Factors Affecting the Soluble-Suspended Distribution of Strontium-90 and Cesium-137 in Dardanelle Reservoir, Arkansas,
W83-03795 5B

ARKANSAS UNIV. AT LITTLE ROCK. DEPT. OF CHEMISTRY.
A Systematic Study to Reduce Trihalomethane Precursors in Little Rock Drinking Water by Combined Alum Coagulation/Powdered Activated Carbon Treatment,
W83-03683 5F

ARKANSAS UNIV. AT MONTICELLO. DEPT. OF NATURAL SCIENCES.
The Effects of Forest Harvest on Water Quality and Aquatic Life (Phase I),
W83-03686 4D

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF AGRONOMY.
A Survey of Soils Irrigated With Arkansas River Water,
W83-03589 3C

Disposal of Household Wastewater in Soils of High Stone Content,
W83-03679 5D

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF GEOLOGY.
Chemistry of the Springs of the Ozark Mountains, Northwestern Arkansas,
W83-03707 2K

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Using Water Distribution System Models,
W83-03641 8B

ASIAN INST. OF TECH., BANGKOK (THAILAND).
Strategies for Water Quality Management in the Chao Phraya River in Thailand,
W83-03845 5G

Recent Developments on Stochastic Programming Model for Water Quality Management,
W83-03846 5G

Modelling a River Water Quality System: A Case Study of Tanshui River in Taiwan,
W83-03847 5G

Water Quality Management in Asia: Basic Issues and Priorities,
W83-03849 5G

ASIAN INST. OF TECH., BANGKOK (THAILAND). DIV. OF ENVIRONMENTAL ENGINEERING.
Indices for Water Quality Assessment in Rivers: A Case Study of the Linggi River in Malaysia,
W83-03844 5A

Establishing Water Quality Objectives and Emission Targets in Rivers,
W83-03848 5G

AUBURN UNIV., AL. DEPT. OF CHEMICAL ENGINEERING.
Phase and Compression Behavior in Sedimentation and Thickening of Liquid-Solid Suspensions,
W83-03727 5D

AUBURN UNIV., AL. DEPT. OF FISHERIES AND ALLIED AQUACULTURES.
Effects on Channel Catfish of High Nitrite Concentrations That Occur in Fish Ponds,
W83-03698 5C

Toxic Effects of Nitrite on Channel Catfish,
W83-03709 5C

BAYERISCHES LANDESAMT FUER WASSERWIRTSCHAFT, MUNICH (GERMANY, F.R.).
Concentration of Heavy Metals in Fishes from the River Danube (Schwermetallgehalt von Fischen aus der Donau),
W83-03504 5C

BAYREUTH UNIV. (GERMANY, F.R.). LEHRSUHL FUER HYDROLOGIE.
Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria/F. R. G. 1. Simple Methods for Calculating 'Acidic Aggressiveness' and Carbonate Dissolution Tendency (Kalk-Kohlensaure-Gleicgewicht in Oberflachennahen Grundwassern Nordostbayerns I. Einfache Gleichgewichtsberechnungen Zur 'Saureaggfressivitat' Und Kalklosungstendenz),
W83-03512 2K

Carbonic Acid-Calcium Carbonate Equilibrium in Surface Groundwaters of Northeastern Bavaria. II. Spatial and Temporal Variances (Kalk -Kohlensaure Gleichgewicht in Oberflachennahen Grundwassern Nordostbayerns. II. Zur Hydrochemischen Raumlichen Und Zeitlichen Varianz),
W83-03514 2K

BEND RESEARCH, INC., OR.
Industrial Water Reuse with Coupled-Transport Membranes,
W83-03604 5D

Novel Composite Membranes,
W83-03678 3A

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
An Improved Understanding of Flow in a Limestone Aquifer Using Field Evidence and Mathematical Models,
W83-03578 2F

BLACK AND VEATCH, DENVER, CO.
Development of a Regional Sludge Dewatering Facility Using Pressure Filters,
W83-03661 5E

BLATCHLEY ASSOCIATES, INC., DENVER, CO.
Discussion: Residential Water Conservation,
W83-03658 3D

BODENSEE-WASSERVERSORGUNG, STUTTGART (GERMANY, F.R.).
The Mid-Term Extension Program for the Bodensee-Wasserversorgung (Der Mittelfristige Ausbau Der Bodensee-Wasserversorgung),
W83-03523 5F

BURNS AND MCDONNELL. KANSAS CITY, MO.
Industrial Wastewater Pretreatment Standards--A Local Approach,
W83-03765 6F

CALIFORNIA COASTAL COMMISSION, SAN FRANCISCO.
Development of Regional Wetland Restoration Goals: Coastal Wetlands,
W83-03691 6G

CALIFORNIA UNIV., BERKELEY. HYDRAULIC ENGINEERING LAB.
Currents in South San Francisco Bay,
W83-03690 5B

CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Injection and Thermal Breakthrough in Fractured Geothermal Reservoirs,
W83-03585 2F

CALIFORNIA UNIV., DAVIS. DEPT. OF CIVIL ENGINEERING.
Filtration of Primary Effluent,
W83-03574 5D

Engineering Wetlands: Circulation, Sedimentation, and Water Quality,
W83-03693 2L

CALIFORNIA UNIV., DAVIS. DIV. OF ENVIRONMENTAL STUDIES.
Effect of Copper on Nitrogen Fixation and Growth of Blue-Green Algae in Natural Plankton Associations,
W83-03837 5F

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
A Modified Line Source Sprinkler Technique for Continuous-Variable Leaching Studies,
W83-03767 3F

CAMBRIDGE UNIV. (ENGLAND). DEPT. OF APPLIED MATHEMATICS AND THEORETICAL PHYSICS.
Separation of Hydraulic Flow Over Topography,
W83-03830 8B

CAMP, DRESSER AND MCKEE, INC., ANNANDALE, VA.
Interactive Nonstructural Flood-Control Planning,
W83-03831 6F

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO).
Discussion of: Industrial Wastes as Carbon Sources in Biological Denitrification,
W83-03576 5D

Assessment of Heavy Metals and PCBs at Sludge Application Sites,
W83-03633 5E

Discussion: Flow Resistance in Coarse Gravel Bed Rivers,
W83-03644 8B

CAPE TOWN UNIV. (SOUTH AFRICA). DEPT. OF CHEMICAL ENGINEERING.
A Dynamic Model of the High-Rate Algal-Bacterial Wastewater Treatment Pond,
W83-03534 5D

CATANIA UNIV. (ITALY). IST. DI BIOLOGIA GENERALE.
Heavy Metal Distribution in Sediments from the Gulf of Catania (Italy),
W83-03803 5B

CEA CENTRE D'ETUDES NUCLEAIRES DE CADARACHE, SAINT-PAUL-LES-DURANCE (FRANCE). SERVICE DE RADIO-AGRONOMIE.
Heavy Water Tracing of Soil-Water Transfers Under Irrigation,
W83-03755 2G

CENTRAL ARID ZONE RESEARCH INST., JODHPUR (INDIA).
A Severe Flood in Luni Basin, Western Rajasthan During July 1979--A Case Study,
W83-03808 2E

CENTRAL ARID ZONE RESEARCH INST., JODHPUR (INDIA). DIV. OF BASIC RESOURCES STUDIES.
Agro-Ecological Regions of Western Rajasthan,
W83-03850 2A

CENTRAL GROUNDWATER BOARD, LUCKNOW (INDIA).
Chemical Composition of Rain Water Over Lucknow in 1980,
W83-03809 2K

CENTRAL SCIENTIFIC-RESEARCH INST. OF MULTIPURPOSE USE OF WATER RESOURCES (USSR).
Calculations of Seepage Losses of Water Bodies Under the Effect of Infiltration Intakes,
W83-03757 2F

CENTRE NATIONAL DE MACHINISME AGRICOLE DU GENIE RURAL, DES EAUX ET DES FORETS, PARIS (FRANCE).
Tests on Aerators: Conclusions Drawn From 500 Clean Water Tests Conducted in 200 Different Sewage Treatment Plants - I Test Procedure (Essais D'Aerateurs Enseignements Tires De 500 Essais En Eu Clair Effectues Dans 200 Stations D'Epuration Differentes - I Methodologie),
W83-03535 5D

CENTRE OCEANOLOGIQUE DE BRETAGNE, BREST (FRANCE).
Toxicity of Organolead Compounds: Study of Bacterial Inactivation by Measurement of ATP (Approche De La Toxicite Des Organo Plombs Etude De L'Inactivation Bacterienne Par Mesures D'ATP),
W83-03510 5C

CH2M/HILL, DENVER, CO. WATER ENGINEERING DEPT.
Total Water Management--The Denver Story,
W83-03746 5D

CHILE UNIV., SANTIAGO. DEPT. OF INORGANIC AND ANALYTICAL CHEMISTRY.
The Nitrogen Balance of Vegetable Crops Irrigated with Untreated Effluent,
W83-03745 5B

CINCINNATI UNIV., OH. DEPT. OF BIOLOGICAL SCIENCES.
Macroinvertebrate Colonization of Multiplate Samplers in the Ohio River: The Effect of Dams,
W83-03824 6G

CLARKSON COLL. OF TECHNOLOGY, POTSDAM, NY. DEPT. OF CHEMICAL ENGINEERING.
Column Design for Recovery of NH3 and CO2 from Wastewater in a Urea Plant,
W83-03748 5D

CLEMSON UNIV., SC.
Displacement of Recreational Users Between the Lower St. Croix and Upper Mississippi Rivers,
W83-03842 6D

CLEMSON UNIV., SC. DEPT. OF AGRICULTURAL ENGINEERING.
Animal Feedlot Runoff in the Piedmont,
W83-03775 5B

CLEMSON UNIV., SC. DEPT. OF AGRONOMY AND SOILS.
Soybean Responses to Irrigation and Tillage on a Compacted Coastal Plains Soil,
W83-03774 2I

CLEMSON UNIV., SC. DEPT. OF CIVIL ENGINEERING.
A Study of the Occurrence of Hydrogen Sulfide in Sewers in the Piedmont Area of South Carolina,
W83-03671 8G

A Finite Element Model to Predict the Flow of Underground Contaminants Due to Leakage of Chemical and/or Radioactive Material From a Buried Containment,
W83-03672 5B

CLEMSON UNIV., SC. DEPT. OF ECONOMICS.
The Estimation and Application of the Demand for Discharge Within the Context of Water Quality Management Systems,
W83-03701 6F

CLEMSON UNIV., SC. DEPT. OF ENVIRONMENTAL SYSTEMS ENGINEERING.
Solubilization Rate of Atmospheric Particulate Matter and Impact on Water Quality,
W83-03677 5B

Effects of Acid Deposition (Rain) on a Piedmont Aquatic Ecosystem: Acid Inputs, Neutralization, and pH Changes,
W83-03700 5C

Clarification Failure Control Strategies,
W83-03828 5D

CLEMSON UNIV., SC. DEPT. OF PLANT PATHOLOGY AND PHYSIOLOGY.
1,2-Dibromo-3-Chloropropane Residues in Water in South Carolina, 1970-80,
W83-03744 5B

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Artificial Groundwater Recharge, San Luis Valley, Colorado,
W83-03562 4B

A River Basin Network Model for Conjunctive Use of Surface and Groundwater: Program CONSIM,
W83-03596 6A

Salt Transport in the Lower South Platte River,
W83-03718 5B

Representative Sampling Location Criterion for Rivers,
W83-03740 5A

COMPAGNIE GENERALE DES EAUX, PARIS (FRANCE).
Methodology for Determining the Presence and Origin of Organic Micropollutants,
W83-03548 5F

COMPAGNIE INTERCOMMUNALE BRUXELLOISE DES EAUX (BELGIUM).
The Elimination of Mineral Micropollutants,
W83-03556 5D

CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN.
Acid Rain: Sources and Effects in Connecticut Report of the Acid Rain Task Force,
W83-03561 2K

CONNECTICUT UNIV., STORRS. INST. OF WATER RESOURCES.
Investigation of Polycyclic Aromatic Hydrocarbons in Water Systems,
W83-03591 5A

River Management Research Needs,
W83-03601 6B

Analysis of Coastal Marsh Ecosystems: Effects of Tides on Vegetational Change,
W83-03708 2L

CORNELL UNIV. AGRICULTURAL EXPERIMENT STATION, ITHACA, NY. DEPT. OF AGRICULTURAL ECONOMICS.
Stated Financing Policies of Government Agencies and the Experience of Rural Water Supply Systems,
W83-03606 6A

CORNELL UNIV., ITHACA, NY. DEPT. OF ENVIRONMENTAL ENGINEERING.
Anaerobic Digestion of Waste Activated Sludge,
W83-03827 5D

CORNELL UNIV., ITHACA, NY. LAB. OF SOIL MICROBIOLOGY.
Effect of Simulated Acid Precipitation on Algal Fixation of Nitrogen and Carbon Dioxide in Forest Soils,
W83-03797 5C

DELAWARE UNIV., NEWARK.
Activated Carbon for Treatment of Cadmium Wastewater,
W83-03825 5D

DELAWARE UNIV., NEWARK. SCHOOL OF LIFE AND HEALTH SCIENCES.
The Effect of Stress on Organisms in the Distribution System,
W83-03602 5A

An Evaluation of Seashore Mallow, Kosteletzkya Virginica (L.) Presl., as a Potential New Crop Which Can Be Grown in Brackish Water,
W83-03618 3C

DELTA CHEMICALS, INC., SEARSPORT, ME.
Chloramines - An Answer to the Trihalomethane Problem,
W83-03625 5F

DEPARTMENT OF AGRICULTURE, OTTAWA (ONTARIO). LAND RESOURCE RESEARCH INST.
Electromagnetic Determination of Soil Water Content Using TDR: I. Applications to Wetting Fronts and Steep Gradients,
W83-03766 7B

Electromagnetic Determination of Soil Water Content Using TDR: II. Evaluation of Installation and Configuration of Parallel Transmission Lines,
W83-03806 7B

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, TAUPO (NEW ZEALAND). ECOLOGY DIV.
Factors Controlling Phytoplankton in Lake Vanda (77 Degrees S),
W83-03838 2H

DEPARTMENT OF SCIENTIFIC SERVICES, SINGAPORE.
The Biodegradation of N-Methyl-2-Pyrrolidone in Water by Sewage Bacteria,
W83-03538 5D

DU PONT DE NEMOURS (E.I.) AND CO., WILMINGTON, DE.
RO vs. MSF for High-Capacity Seawater Desalination Plants,
W83-03622 3A

DUFRESNE-HENRY, INC., CONCORD, MA.
Engineering and Legal Ramifications of Groundwater Contamination - A Case Study,
W83-03626 5G

DUFRESNE-HENRY, INC., NORTH SPRINGFIELD, VT. SOLID WASTE DEPT.
Source Protection - An Ounce of Prevention,
W83-03627 5G

DUKE UNIV., DURHAM, NC. SCHOOL OF FORESTRY AND ENVIRONMENTAL STUDIES.
State Options for Nonstructural Flood Risk Management,
W83-03702 6F

EAST CAROLINA UNIV., GREENVILLE, NC. DEPT. OF BIOLOGY.
Biogeochemistry of the Sediments of the Pamlico and Neuse River Estuaries, North Carolina,
W83-03620 2L

Significance of Floodplain Sediments in Nutrient Exchange Between a Stream and its Floodplain,
W83-03724 2H

ECOLE NATIONALE SUPERIEURE DES MINES DE PARIS, FONTAINEBLEAU (FRANCE). CENTRE D'INFORMATION GEOLOGIQUE.
A Method To Compute River Heating - Application to the Management of Thermal Loadings to the Rhine River (Une Methode De Calcul De L'Echauffement Des Rivieres - Application a La Gestion Des Rejets Themiques Au Rhin),
W83-03584 5G

EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND). VERSUCHSANSTALT FUER WASSERBAU, HYDROLOGIE UND GLAZIOLOGIE.
Automatic Determination of Snow Cover (Schneedecke Automatisch Erfasst),
W83-03529 7B

ENGINEERING-SCIENCE, INC., ARCADIA, CA.
The Masonry Sewers of Aleppo,
W83-03655 5D

ENVIRO ENTERPRISES, INC., SALT LAKE CITY, UT.
Fine-Coal-Aided Centrifugal Dewatering of Waste Activated Sludge,
W83-03659 5E

ENVIRONMENTAL POLLUTION RESEARCH CENTER, IBARAKI PREFECTURE, MITO (JAPAN).
Organically-Bound Copper in Lake and River Waters in Japan,
W83-03536 5B

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH. DRINKING WATER RESEARCH DIV.
Research Needs for Water Supply Cost Estimating,
W83-03648 6B

ESCUELA POLITECNICA NACIONAL, QUITO (ECUADOR).
Effect of Polyelectrolytes on Biofilm Growth,
W83-03826 5D

ETHYL CORP., BATON ROUGE, LA.
Variables Affecting Metal Removal from Sludge,
W83-03581 5E

FLORIDA UNIV., GAINESVILLE. DEPT. OF CIVIL ENGINEERING.
Movement of Salt and Hazardous Contaminants in Groundwater Systems,
W83-03619 5B

FLORIDA WATER RESOURCES RESEARCH CENTER, GAINESVILLE.
The Reactions of Chlorine Disinfectant With Organics Adsorbed on Granular Activated Carbon,
W83-03624 5F

Mineralogical Model of the Floridan Aquifer in the Southwest Florida Water Management District,
W83-03670 2F

The Effect of Excess and Limited Soil Moisture on Nitrogen Fixation of Several Leguminous Crops,
W83-03687 2I

FLOW LABS., INC., INGLEWOOD, CA. ENVIRNMENTAL CULTURES DIV.
Discussion of: Effect of a Bacterial Culture Product on Biological Kinetics,
W83-03571 5D

FOOD AND DRUG ADMINISTRATION, DAVISVILLE, RI. SHELLFISH SANITATION BRANCH.
Enterococci and Other Microbial Indicators in Municipal Wastewater Effluents,
W83-03551 5A

GEOMET TECHNOLOGIES, INC., ROCKVILLE, MD.
Managing the Risk and Liability of Toxic Contamination of Water Supply,
W83-03630 6F

GUELPH UNIV. (ONTARIO). DEPT. OF LAND RESOURCE SCIENCE.
Hydrodynamic Dispersion Involving Cationic Adsorption During Unsaturated, Transient Water Flow in Soil,
W83-03749 2G

Agriculture and Water Quality in the Canadian Great Lakes Basin: III. Phosphorus,
W83-03841 5B

GUILFORD COLL., GREENSBORO, NC. DEPT. OF GEOLOGY AND EARTH SCIENCES.
Geophysical Mapping Techniques for Groundwater Availability, Central Piedmont Province, North Carolina,
W83-03612 3B

HALEY AND ALDRICH, INC., CAMBRIDGE, MA.
Factors Affecting Stress Cell Measurements in Soil,
W83-03657 8D

HARDING-LAWSON ASSOCIATES, NOVATO, CA.
Dynamic Analysis of Earth Dams in Three Dimensions,
W83-03651 8D

HAWAII UNIV. AT MANOA, HONOLULU.
Water Resources Bibliography of Hawaii,
W83-03730 10C

HAWAII UNIV. AT MANOA, HONOLULU. WATER RESOURCES RESEARCH CENTER.
Water Balance of the Pearl Harbor-Honolulu Basin, Hawaii, 1946-1975,
W83-03673 4B

Population Biology in Small Hawaiian Streams,
W83-03676 6G

Water Quality of Airport Storm Runoff, Phase II,
W83-03688 5B

Efficient Pricing and Financing of Urban Water: The Role of Development Charges,
W83-03689 6C

Mineralogy of Sediments in Three Estuaries on Oahu, Hawaii,
W83-03728 2L

Stream-Water Storage in the Ocean Using an Impermeable Membrane,
W83-03772 3B

Water Rights, Water Regulation, and the 'Taking Issue' in Hawaii,
W83-03779 6E

Soil Parameters and Sampling Scheme for Characterizing Soil Hydraulic Properties of a Watershed,
W83-03817 2G

HIRSCH AND CO., SAN DIEGO, CA.
Innovative Technology Recycles Waste.
W83-03545 5D

IDAHO UNIV., MOSCOW. COLL. OF FORESTRY, WILDLIFE AND RANGE SCIENCES.
The Fate, Distribution and Limnological Effects of Volcanic Tephra in the St. Joe and Coeur D'Alene River Deltas of Lake Coeur D'Alene, Idaho,
W83-03597 5B

Aquaculture Techniques: A Computer Simulation of an Intensive Fish Culture System (Aqua),
W83-03685 8I

ILLINOIS UNIV. AT THE MEDICAL CENTER, CHICAGO. SCHOOL OF PUBLIC HEALTH.
Enumeration of Chlorine-Damaged Fecal Coliforms in Wastewater Effluents,
W83-03632 5D

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF AGRICULTURAL ECONOMICS.
Administrative Coordination in the Implementation of Agricultural Nonpoint Pollution Controls,
W83-03559 6E

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF AGRICULTURAL ENGINEERING.
Dredged Sediment for Agriculture: Lake Paradise, Mattoon, Illinois,
W83-03558 3F

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF AGRONOMY.
A 'Micro-Lysimter' Method for Determining Evaporation From Bare Soil: Description and Laboratory Evaluation,
W83-03783 2D

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF LANDSCAPE ARCHITECTURE, URBAN, AND REGIONAL PLANNING.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W83-03580 6A

IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND). PUBLIC HEALTH ENGINEERING LAB.
Removal of Nitrilotriacetic Acid During Primary Sedimentation and Its Effect on Metal Removal,
W83-03813 5D

INDIAN INST. OF TECH., NEW DELHI. CENTRE FOR ATMOSPHERIC AND FLUIDS SCIENCES.
On the Role of Large Scale Energetics in the Onset and Maintenance of Summer Monsoon--II: Moisture Budget,
W83-03786 2B

INSPECTORAT CANTONNAL DES EAUX, LAUSANNE (SWITZERLAND).
Evolution of Nitrate Concentrations in Groundwater in the Middle Vaud Region (Switzerland) (Evolution Des Concentrations en Nitrates Des Eaux Souterraines Du Moyen-Pays Vaudois),
W83-03508 5B

INSTITUT FUER WASSERWIRTSCHAFT, BERLIN (GERMANY, F.R.).
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W83-03519 5D

INSTITUT NATIONAL DE LA RECHERCHE SCIENTIFIQUE, SAINTE-FOY (QUEBEC).
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W83-03839 5G

INSTITUT PASTEUR DE LYON (FRANCE). LAB. DE TOXICOLOGIE.
Survey of Trihalomethane Levels in Rhone-Alps Water Supplies. Estimates on the Formation of Chloroform in Wastewater Treatment Plants and Swimming Pools,
W83-03540 5B

INSTITUTO ARGENTINO DE OCEANOGRAFIA, BUENOS AIRES. LAB. DE QUIMICA MARINA.
Cu, Cd and Zn in Blanca Bay Surface Sediments, Argentina,
W83-03802 5B

IOWA COOPERATIVE FISHERY RESEARCH UNIT, AMES.
Factors Influencing Dieldrin and DDT Residues in Carp from the Des Moines River, Iowa, 1977-80,
W83-03743 5B

IOWA STATE UNIV., AMES. DEPT. OF CIVIL ENGINEERING.
Technology Transfer Program: Urban Stormwater Management Implementation in Iowa,
W83-03696 4A

ISTANBUL UNIV. (TURKEY). FEN FAKULTESI.
Environmental Limiting Factors Affecting the Growth and Spread of Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur Lake (Die Umweltfaktoren, Die Die Verbreitung Und Entwicklung Von Chalcalburnus Tarichi (Pall. 1881) (Pisces: Cyprinidae) in Burdur-See Begrenzen),
W83-03543 5C

JOHANNESBURG CITY HEALTH DEPT. LABS. (SOUTH AFRICA).
The Suitability of M-Endo-LES Agar for Total Coliform Counts by Membrane Filtration,
W83-03762 5A

JOHNS HOPKINS UNIV., BALTIMORE, MD. DEPT. OF GEOGRAPHY AND ENVIRONMENTAL ENGINEERING.
A Research Agenda for Municipal Water Demand Forecasting,
W83-03640 6D

KENTUCKY WATER RESOURCES RESEARCH INST., LEXINGTON.
Studies in Dye-Tracing Techniques and Karst Hydrogeology,
W83-03599 5B

Predicting Infiltration and Surface Runoff from Reconstructed Spoils and Soils,
W83-03610 4C

Movement of Bacteria Through Macropores to Ground Water,
W83-03705 5B

KEURINGSINSTITUUT VOOR WATERLEIDINGARTIKELEN, RIJSWIJK (NETHERLANDS).
Methodology of Research Concerning Micropollutants: Biological Tests,
W83-03554 5A

LAGUNA LAKE DEVELOPMENT AUTHORITY, MANILA (PHILIPPINES). ENVIRONMENTAL PROTECTION DIV.
The Comprehensive Water Quality Management Program for the Laguna De Bay in the Philippines,
W83-03843 5G

LENINGRAD MINING INST. (USSR).
Numerical Modeling of Groundwater Flow Processes,
W83-03771 2F

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF CHEMICAL ENGINEERING.
Waste Water Treatment by Ligand Exchange,
W83-03706 5D

LYCOTT ENVIRONMENTAL RESEARCH, INC., SOUTHBRIDGE, MA.
Reservoir Eutrophication and Management,
W83-03629 5G

MAINE UNIV. AT ORONO. COLL. OF EDUCATION.
Teacher's Resource Guide on Acidic Precipitation with Laboratory Activities,
W83-03565 2K

MAINE UNIV. AT ORONO. DEPT. OF CIVIL ENGINEERING.
Removal of Radon from Water Using Granular Activated Carbon Adsorption,
W83-03564 5F

MARYLAND UNIV., SOLOMONS. CHESAPEAKE BIOLOGICAL LAB.
Instream Flow Requirements for Fish and Fisheries in Maryland,
W83-03776 2E

MASSACHUSETTS UNIV., AMHERST. DEPT. OF CIVIL ENGINEERING.
River Basin Water Quality Monitoring Network Design,
W83-03593 5A

MASSACHUSETTS UNIV., AMHERST. WATER RESOURCES RESEARCH CENTER.
Evaluation of Alternative Procedures for Review of Water Resources Research Proposals,
W83-03600 9D

MASSEY UNIV., PALMERSTON NORTH (NEW ZEALAND). DEPT. OF SOIL SCIENCE.
Constant-Flux Infiltration From a Hemispherical Cavity,
W83-03782 2G

METCALF AND EDDY, INC., BOSTON, MA.
Increasing Rockport's Water Supply,
W83-03662 6D

METEOROLOGICAL OFFICE, CALCUTTA (INDIA).
Path of a Vortex in a Semi-Infinite Region With a Streaming Motion along a Plane Wall Boundary Having a Semicircular Bay or Bulge,
W83-03807 2E

METEOROLOGICAL OFFICE, PATNA (INDIA).
Hydrometeorological Study of Severe Rainstorms of North Bihar,
W83-03788 2B

METEOROLOGICAL OFFICE, POONA (INDIA).
Probabiliity Analysis of Short Period Rainfall in Dry Farming Tract in India,
W83-03800 2B

A Signal Recording and Printing System for Telemetering Raingauges,
W83-03801 7B

METEOROLOGICAL SERVICE, VACOAS (MAURITIUS).
An Analysis of Mauritian Winter Rainfall,
W83-03787 2B

MINISTERE DE LA SANTE ET DE LA SECURITE SOCIALE, PARIS (FRANCE)
Sanitary Monitoring of Seawater in Bathing Areas of France (Surveillance Sanitaire Des Eaux De Baignade En Mer En France),
W83-03515 5G

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. DEPT. OF CIVIL ENGINEERING.
The Feasibility of Engineering-Economic-Management Alternatives for Meeting Water Demands in Tupelo-Lee County, Mississippi,
W83-03722 6D

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. WATER RESOURCES RESEARCH INST.
Legal Analysis of the Lee County Water Supply Problem,
W83-03720 6E

Institutional Framework for Conjunction Use of Surface and Groundwater in Tupelo-Lee County, Mississippi: Phase II,
W83-03721 4B

MISSOURI UNIV.-COLUMBIA. DIV. OF BIOLOGICAL SCIENCES.
Diatoms of Lake of the Ozarks, Missouri,
W83-03723 2H

MISSOURI UNIV.-ROLLA. DEPT. OF CIVIL ENGINEERING.
Preliminary Evaluation of the Pretreatment of Fuel Alcohol Fermentation Stillage Through an Anaerobic Filter,
W83-03664 5D

The Use of Field Crop Residues for Sand Filter Modification of Small Community Wastewater Stabilization Ponds to Meet Secondary Treatment Requirements and Recovery of Plant Nutrient Resources,
W83-03665 5D

MISSOURI WATER RESOURCES RESEARCH CENTER, COLUMBIA.
An Innovative Approach of Operating Rotating Biological Contactor Using Pure Oxygen,
W83-03666 5D

MONTANA AGRICULTURAL EXPERIMENT STATION, BOZEMAN.
Salt Status of Glacial Till Soils of North-Central Montana as Affected by the Crop-Fallow System of Dryland Farming,
W83-03769 2G

MONTANA UNIV., MISSOULA. DEPT. OF BOTANY.
A Preliminary Investigation Into the Use of Crayfish as a Sensitive Species to Pollutants in the Clark Fork River Near Missoula, MT,
W83-03617 5B

MONTGOMERY (JAMES M.), INC., PASADENA, CA.
The Interior Surface of Galvanized Steel Pipe: A Potential Factor in Corrosion Resistance,
W83-03650 8G

MONTPELLIER-2 UNIV. (FRANCE). LAB. DE GENIE CHIMIQUE, TRAITMENT ET EPURATION DES EAUX.
Hydrocarbon Removal in a Three-Phase Fluidized Experimental Bed and Modelling of the Process (Epuration Hydrocarbonne en Couche Fluidisee Triphasique Etude Experimentale et Modelisation),
W83-03531 5D

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH.
Predicting Future Water Demand,
W83-03835 6D

NAPIER COLL., EDINBURGH (SCOTLAND). DEPT. OF BIOLOGICAL SCIENCES.
Water Quality in the Firth of Forth,
W83-03784 5D

NATIONAL BUREAU OF STANDARDS, WASHINGTON, DC. NATIONAL ENGINEERING LAB.
Evaluation of a Dissolved Oxygen Field Test Protocol,
W83-03631 7B

NATIONAL INST. FOR WATER RESEARCH, PRETORIA (SOUTH AFRICA).
Harvesting of Algae Grown on Raw Sewage,
W83-03737 5D

NATIONAL TECHNICAL UNIV., ATHENS (GREECE). APPLIED HYDRAULICS LAB.
Discussion: Boundary Shear in Smooth and Rough Channels,
W83-03652 8B

NAVAL RESEARCH LAB., WASHINGTON, DC.
Silicones in Chesapeake Bay Sediments,
W83-03804 5B

NEEDHAM PUBLIC WORKS DEPT., MA.
Natural Gas Proves to be Economical for Pumping Water,
W83-03715 8C

NEVADA UNIV. SYSTEM, RENO. DESERT RESEARCH INST.
A Parametric Model for Peak Flow Prediction in Ungaged Ephemeral Watersheds,
W83-03778 2A

Relationships Among Precipitation, Snowmelt, Subsurface Flow, Groundwater Recharge, and Streamflow Generation in the Clear Creek Watershed, Eastern Sierra Nevada,
W83-03822 2A

NEW MEXICO STATE UNIV., LAS CRUCES. DEPT. OF AGRICULTURAL ENGINEERING.
Water-Use Production Functions of Selected Agronomic Crops in Northwestern New Mexico, Phase II,
W83-03560 2D

NEW YORK STATE COLL. OF AGRICULTURE AND LIFE SCIENCES, ITHACA. DEPT. OF AGRICULTURAL ENGINEERING.
Water Conservation and Groundwater Recharge on Eastern Long Island,
W83-03703 2F

NEW YORK STATE COLL. OF HUMAN ECOLOGY, ITHACA. DEPT. OF DESIGN AND ENVIRONMENTAL ANALYSIS.
An Investigation of the Chemistry of Degradation of Pesticides and Other Serious Organic Contaminants in Drinking Water for Application to Domestic and Community Water Supplies,
W83-03725 5F

NEW YORK STATE DEPT. OF HEALTH, ALBANY.
2,3,7,8-Tetrachlorodibenzo-p-Dioxin in Sediment Samples From Love Canal Storm Sewers and Creeks,
W83-03814 5A

NEWCASTLE AND GATESHEAD WATER CO., NEWCASTLE-UPON-TYNE (ENGLAND).
New Correction Procedures for Chromate Interference in the DPD Method for Residual Free and Combined Chlorine in Water,
W83-03579 5A

NIGERIA UNIV., NSUKKA.
Filtrability and Compressibility of Sludges, Part 1,
W83-03790 5E

NORDOSTSCHWEIZERISCHE KRAFTWERKE A.G., BADEN.
Inquiry into Tax gains for Members of Partnerships (Steuerliche Gewinnermittlung Bei Partnerwerken),
W83-03530 6C

NORTH CAROLINA DEPT. OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT, RALEIGH.
Coastal Pollution from Septic Tank Drainfields,
W83-03836 5B

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF BOTANY.
Nutrient and Multi-Species Criteria Standard for the Chowan River, North Carolina,
W83-03623 5C

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF HORTICULTURAL SCIENCE.
Growth, Development, and Root Quality of Sweet Potato as Influenced by Soil Warming,
W83-03615 3C

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF MARINE, EARTH AND ATMOSPHERIC SCIENCES.
Ground Water Yields and Availability in Fractured Crystalline Rocks, Wake County, North Carolina,
W83-03733 2F

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF SOIL SCIENCE.
A Permeameter Which Eliminates Boundary Flow Errors in Saturated Hydraulic Conductivity Measurements,
W83-03770 7B

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF WOOD AND PAPER SCIENCE.
Enzymatic Pretreatment of Pulp Mill Effluents Prior to Decolorization by Lime Precipitation,
W83-03603 5D

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF ZOOLOGY.
The Freshwater Asian Clam (Corbicula Fluminea) as a Factor Affecting Nutrient Cycling in the Chowan River, N.C.,
W83-03588 5B

NORTH CAROLINA UNIV. AT CHAPEL HILL.
Variations in Monthly Precipitation Over North Carolina,
W83-03598 7C

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF CITY AND REGIONAL PLANNING.
Making Waves: Public Participation in State Water Planning,
W83-03614 6F

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.
Discussion of: Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds and Nitrogen Dynamics in Waste Stabilization Ponds,
W83-03573 5D

Research Needs for Capacity Planning,
W83-03639 6D

Kinetics of Phosphorus Uptake in the Chowan River, North Carolina,
W83-03711 5B

Nitrogen Fixation and Denitrification in the Pamlico River, North Carolina,
W83-03712 5B

The Effects of Bottom Water Anoxia on Benthnic Nutrient Flux Rates in the Pamlico River,
W83-03713 5C

A Study of Radium-226 and Radon-222 Concentration in Ground Water Near a Phosphate Mining and Manufacturing Facility with Emphasis on the Hydrogeologic Characteristics of the Area,
W83-03714 5B

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF GEOLOGY.
Sources and Fates of Sedimentary Organic Matter in the White Oak and Neuse River Estuaries,
W83-03590 5B

NORTH CAROLINA UNIV. AT CHAPEL HILL. INST. OF MARINE SCIENCES.
Factors Regulating Nuisance Blue-Green Algal Bloom Potentials in the Lower Neuse River, N.C.,
W83-03566 5C

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF CHEMISTRY.
Second Row Molecular Orbital Calculations. 5. A Minimal Basis Indo for Na-Cl,
W83-03613 1B

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF ZOOLOGY.
Seasonal Losses of N sub 2, H sub 2S and CH sub 4 from Sediments to the Atmosphere from Wetlands in the Arrowwood National Wildlife Refuge, North Dakota,
W83-03719 5A

NORTH DAKOTA UNIV., GRAND FORKS. DEPT. OF BIOLOGY.
Fate of Herbicides in Groundwater and Surface Runoff and Their Biotic Effects on Prairie Potholes,
W83-03682 5B

NORTH DAKOTA UNIV., GRAND FORKS. DEPT. OF GEOLOGY.
Effect of Seepage from Unlined Municipal Waste Stabilization Lagoons on Chemical Quality of Groundwater in Shallow Aquifers,
W83-03731 5B

NOVA SCOTIA DEPT. OF MUNICIPAL AFFAIRS, HALIFAX. COMMUNITY PLANNING DIV.
Alternative Wastewater Management Strategies for Rural and Urban-Fringe Communities,
W83-03823 5D

OAK RIDGE NATIONAL LAB., TN.
Micropollutants Produced by Disinfection of Wastewater Effluents,
W83-03546 5D

OAKLAND COUNTY DRAIN COMMISSIONER'S OFFICE, PONTIAC, MI.
Lake Weir Designed to Resist Ice Damage,
W83-03681 8A

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER, WOOSTER.
Calculating the Depths of Soil Moisture Control Sections From Laboratory Data,
W83-03780 2G

OKLAHOMA STATE UNIV., STILLWATER. SCHOOL OF CIVIL ENGINEERING.
Biological Treatability of Specific Organic Compounds Found in Chemical Industry Wastewaters,
W83-03550 5D

Impact of Artificial Recharge on Groundwater Quality of Gypsum Aquifer in Harmon County, Oklahoma,
W83-03607 5B

Removal Mechanisms for Toxic Priority Pollutants,
W83-03647 5D

OREGON STATE UNIV., CORVALLIS. AGRICULTURAL EXPERIMENT STATION.
Perched Water Tables on Hillsides in Western Oregon: II. Preferential Downslope Movement of Water and Anions,
W83-03751 2G

Perched Water Tables on Hillsides in Western Oregon: I. Some Factors Affecting Their Development and Longevity,
W83-03768 2G

OREGON STATE UNIV., CORVALLIS. DEPT. OF AGRICULTURAL AND RESOURCE ECONOMICS.
Water Rights Transfers: A Legal, Economic, and Informational Analysis of Water in Oregon,
W83-03594 6E

OREGON STATE UNIV., CORVALLIS. DEPT. OF FOREST ENGINEERING.
A Dew-Point Hygrometer for Field Use,
W83-03796 7B

PIRNIE (MALCOLM), INC., NEWPORT NEWS, VA.
Measurement and Validity of Oxygen Uptake as an Activated Sludge Process Control Parameter,
W83-03569 5D

PORT ELIZABETH UNIV. (SOUTH AFRICA).
Metal Surveys in South African Estuaries VI. Sundays River,
W83-03739 5B

PORT ELIZABETH UNIV. (SOUTH AFRICA). DEPT. OF ZOOLOGY.
Metal Surveys in South African Estuaries V. Kromme and Gamtoos River (St. Francis Bay),
W83-03738 5B

PURDUE UNIV., LAFAYETTE, IN. AGRICULTURAL EXPERIMENT STATION.
Parameters for Describing Soil Detachment Due to Single Waterdrop Impact,
W83-03750 2J

PURDUE UNIV., LAFAYETTE, IN. WATER RESOURCES RESEARCH CENTER.
The Impact of Urbanization on a Flood-Plain Aquifer: Bloomington, Indiana,
W83-03609 5B

Integration of Management Methods with the Life Cycle and Ecology of the Filamentous Alga, Pithophora,
W83-03680 4A

Occurrence Probabilities of Antecedent Moisture Condition Classes in Indiana,
W83-03818 2A

Total Organic Halogen (TOX) Concentrations in the West Lafayette Wastewater Treatment Plant Effluent and the Wabash River,
W83-03819 5E

QUEENSLAND INST. OF TECH., BRISBANE (AUSTRALIA).
Discussion: Minimum Specific Energy in Compound Open Channel,
W83-03653 8B

RESEARCH INST. OF FORESTS AND RANGELANDS, TEHRAN (IRAN).
Water Harvesting for Afforestation: III. Dependence of Tree Growth on Amount and Distribution of Precipitation,
W83-03752 3B

RESOURCES FOR THE FUTURE, INC., WASHINGTON, DC.
Economic Research Needs Relevant to Improved Drinking Water Quality,
W83-03637 6B

RHODE ISLAND UNIV., KINGSTON. DEPT. OF PLANT AND SOIL SCIENCE.
Land Application of Sewage Sludge Landfill Leachate,
W83-03563 5E

RHODE ISLAND UNIV., KINGSTON. WATER RESOURCES CENTER.
Analysis of Critical Water Problems in the Northeastern United States to Determine Essential Research Requirements,
W83-03592 6B

SAINT OLAF COLL., NORTHFIELD, MN. DEPT. OF BIOLOGY.
Acidification Effects on Macroinvertebrates and Fathead Minnows (Pimephales Promelas) in Outdoor Experimental Channels,
W83-03532 5C

SAN DIEGO STATE UNIV., CA.
Restoration Techniques, Research, and Monitoring: Vegetation,
W83-03694 2L

SERVICOS DE ENGENHARIA EMILIO BAUMGART LTD., BELO HORIZONTE (BRAZIL).
Treatment of Raw Wastewater Overflows by Dissolved-Air Flotation,
W83-03575 5D

SHIBER CONSULTANTS, SAFAT (KUWAIT).
Plastic Pellets on Spain's 'Costa Del Sol' Beaches,
W83-03785 5B

SLOPE INDICATOR CO., SEATTLE, WA.
Discussion: Piezometers in Earth Dam Impervious Sections,
W83-03643 8G

SOIL AND IRRIGATION RESEARCH INST., PRETORIA (SOUTH AFRICA). DEPT. OF AGRICULTURE AND FISHERIES.
A Review of the Use of Dyes as Soil Water Tracers,
W83-03736 2G

SOIL CONSERVATION SERVICE, GAINESVILLE, FL.
Field Vs. Laboratory Determined Hydraulic Conductivities of Some Slowly Permeable Horizons,
W83-03781 2G

SORENSEN (JENS) AND ASSOCIATES, SAN DIEGO, CA.
Towards an Overall Strategy in Designing Wetland Restorations,
W83-03695 4D

SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF CHEMISTRY.
Development of a Chemical Analysis for Ultratrace Arsenic in Water,
W83-03567 5A

SOUTHWEST MISSOURI STATE UNIV., SPRINGFIELD. DEPT. OF AGRICULTURE.
Optimum Water Use In Fruit Crop Production,
W83-03669 3F

STICHTING VOOR BODEMKARTERING, WAGENINGEN (NETHERLANDS).
Measuring the Hydraulic Conductivity of Soil Horizons With Continuous Macropores,
W83-03754 2G

STROH BREWERY CO., DETROIT, MI.
Monitoring Water Quality Parameters from Municipal Water Intakes,
W83-03568 5F

STUTTGART UNIV. (GERMANY, F.R.). INST. FUER SIEDLUNGSWASSERBAU, WASSERGUETE- UND ABFALLWIRTSCHAFT.
Investigation of the Solidification of Wastewater Concentrates with Inorganic Binding Agents (Untersuchungen Uber die Verfestigung von Abwasserkonzentraten mit Anorganischen Bindemitteln),
W83-03505 5E

Bacterial Growth on Ion Exchange Resin - Investigations with a Strong Cationic Exchanger. Part 1: Attachment and Distribution of Bacteria: Operational Possibilities of Supressing Bacterial Growth (Bakterienwachstum Auf Ionenaustauscher-Harz-Untersuchungen an Einem Stark Sauren Kationen-Austauscher. Teil 1: Anhaftung Und Verteilung Der Bakterien; Betriebliche Moglichkeiten Der Wachstums-Unterdruckung),
W83-03507 5F

SUISELECTRA INGENIEURUNTERNEHMUNG A.G., BASEL.
The Weinzodl Power Plant on the Mur (Das Murkraftwerk Weinzodl),
W83-03526 8A

SWEDISH WATER AND WASTE WATER WORKS ASSOCIATION, STOCKHOLM.
Elimination of Organic Micropollutants,
W83-03547 5D

SYRACUSE UNIV., NY. DEPT. OF CIVIL ENGINEERING.
Caco3 Neutralization of Acidified Surface Waters,
W83-03834 5G

SYSTEMS ARCHITECTS ENGINEERS, INC., SEATTLE, WA.
Pollutant Loading Model for Highway Runoff,
W83-03829 5B

TAHAL CONSULTING ENGINEERS LTD., TEL-AVIV (ISRAEL).
Magnesium Recycling by Carbonation and Centrifugation of High-Lime Wastewater Sludge,
W83-03660 5E

TECHNICAL UNIV. OF ISTANBUL (TURKEY). DEPT. OF ENVIRONMENTAL ENGINEERING.
Dispersion in the Inclined Plane Model of Trickling Filters,
W83-03537 5D

TECHNISCHE UNIV., DRESDEN (GERMAN D.R.). BEREICH HYDROBIOLOGIE.
Performance Improvement with Broad-Crowned Spillways (Leistungssteigerung Breitkroniger Uberfalle),
W83-03518 8A

On the Methodology of Design and Use of Monitoring and Control Programs for Groundwater Management Facilities (Zur Methodik Des Aufbaus Und Der Nutzung Von Kontroll- Und Steuerungsprogrammen Von Grundwasserfassungsanlagen),
W83-03522 5F

TECHNISCHE UNIV., MUNICH (GERMANY, F.R.). INST. FUER WASSERCHEMIE UND CHEMISCHE BALNEOLOGIE.
Hydrogeochemical Investigations with Regard to the Origin of Heavy Metals in Groundwater (Hydrogeochemische Untersuchungen Zur Herkunft Von Schwermetallen Im Grundwasser),
W83-03511 2K

TEXAS AGRICULTURAL EXPERIMENT STATION, COLLEGE STATION.
Surface Soil Physical Properties After 36 Years of Cropping to Winter Wheat,
W83-03805 2J

TEXAS TECH UNIV., LUBBOCK.
Guidelines for Sampling Ground Water,
W83-03582 5A

TEXAS UNIV. AT AUSTIN. DEPT. OF ENVIRONMENTAL HEALTH ENGINEERING.
Groundwater Resources of the Texas Rio Grande Basin,
W83-03503 2F

TEXAS UNIV. AT AUSTIN. DEPT. OF GEOLOGICAL SCIENCES.
Growth of the Municipal Water System in Ciudad Juarez, Mexico,
W83-03502 5F

TIPPETTS-ABBETT-MCCARTHY-STRATTON, NEW YORK.
Routing Graded Sediments in Streams: Applications,
W83-03832 2J

Routing Graded Sediments in Streams: Formulations,
W83-03833 2J

TOHOKU UNIV., SENDAI (JAPAN). DEPT. OF CIVIL ENGINEERING.
Oxidation of Ferrous Iron by Acidophilic Iron-Oxidizing Bacteria From a Stream Receiving Acid Mine Drainage,
W83-03541 5B

TORONTO UNIV. (ONTARIO). DEPT. OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY.
Nature and Origin of Micropollutants,
W83-03555 5B

UKRAINSKII NAUCHNO-ISSLEDOVATEL'SKII INST. GIDROTEKHNIKI I MELIORATSII, KIEV (USSR).
Use of Natural Underground Reservoirs for Control of Surface Runoff,
W83-03758 4B

UNIVERSITAET DES SAARLANDES, SAARBRUECKEN (GERMANY, F.R.).
Coliphages and Coliform Bacteriain Running Waters of Different Quality (Coliphagen und Coliforme Bakterien in Fliessgewassern Unterschiedlicher Gute),
W83-03513 5A

UNIVERSITY COLL., DUBLIN (IRELAND).DEPT. OF INDUSTRIAL MICROBIOLOGY.
The Adsorption of Bovine Serum Albumin by Activated Sludge,
W83-03533 5D

UTAH STATE UNIV., LOGAN. INST. FOR SOCIAL SCIENCE RESEARCH ON NATURAL RESOURCES.
Water Transfers from Agriculture to Industry: Two Utah Examples,
W83-03821 6D

UTAH WATER RESEARCH LAB., LOGAN.
Hydraulics of Solving Unsteady Debris Flows,
W83-03608 8B

VEB PROJEKTIERUNG WASSERWIRTSCHAFT, HALLE (GERMAN D.R.).
Preferred Solutions and Development Trends for Wastewater Conveyance in Drainage Networks (Vorzugslosungen Und Entwicklungstendenzen Der Abwasserforderung in Entwasserungsnetzen),
W83-03517 5D

VIZGAZDALKODASI TUDOMANYOS KUTATO INTEZET, BUDAPEST (HUNGARY).
Pilot Plant Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W83-03792 5D

VSESOYUZNYI NAUCHNO-ISSLEDOVATEL'SKII INST. GIDROGEOLOGII I INZHENERDOI GEOLOGII, MOSCOW (USSR).
Combined Movement of Groundwaters and Moisture of the Zone of Aeration,
W83-03542 2F

Some Current Problems in Investigations of the Interaction of Subsurface and Surface Waters of the USSR,
W83-03734 6D

VYSOKA SKOLA CHEMICKO-TECHNOLOGICKA, PRAGUE (CZECHOSLOVAKIA). INST. OF WATER TECHNOLOGY AND ENVIRONMENTAL PROTECTION.
Biological Problems in Cooling Water Circulation (Biologische Probleme im Kuhlwasserkreislauf),
W83-03528 5B

WASSERWIRTSCHAFTSDIREKTION ODER HAVEL, POTSDAM (GERMAN D.R.).
Results of Lake Cleanup in the Order-Havel Catchment Areas (Ergebnisse Der Seesanierung Aus Dem Einzugsgebiet Der Wwd Order-Havel),
W83-03516 5G

Water pollution Due to Industrial Trout Production in Fish Farms (Gewasserbelastung Durch Industriemassige Forellenproduktion in Rinnenanlagen),
W83-03520 5B

WATER RESEARCH CENTRE, MARLOW (ENGLAND).
Organic Micropollutants in Effluent Recharge to Groundwater,
W83-03553 5B

WATER RESEARCH CENTRE, STEVENAGE (ENGLAND).
Influence of Micropollutants on Vegetation,
W83-03552 5C

WATER RESOURCES COMMISSION OF NEW SOUTH WALES, SYDNEY (AUSTRALIA).
Discussion: Long-Term Performance of Embankment Dam Instrumentation,
W83-03642 8G

WELSH WATER AUTHORITY, POWYS (WALES). DIRECTORATE OF SCIENTIFIC SERVICES.
A Question of Sampling,
W83-03595 7B

WEST VIRGINIA UNIV., MORGANTOWN. DEPT. OF ECONOMICS.
Water Pricing Research Needs,
W83-03649 6C

WEST VIRGINIA UNIV., MORGANTOWN. WATER RESEARCH INST.
Evaluation of Acid-Mine-Water Generation and Acid-Mine-Drainage Potential of Coal and Coal-Associated Rocks,
W83-03820 5B

WISCONSIN DEPT. OF NATURAL RESOURCES, MADISON.
Alternative Methods of Estimating Pollutant Loads in Flowing Water,
W83-03557 5A

WISCONSIN DEPT. OF NATURAL RESOURCES, RHINELANDER.
Impact of Snowmelt-Runoff from Agricultural Watersheds on Dissolved Oxygen,
W83-03636 5B

WISCONSIN UNIV.-MADISON. DEPT. OF AGRICULTURAL ECONOMICS.
An Institutional Perspective on the Use of Natural Resources and the Irrigation and Nitrate Contamination Problem,
W83-03587 6B

WISCONSIN UNIV.-MADISON. DEPT. OF WATER CHEMISTRY.
Silica in Lakes: Nutrient Competition, Equilibrium Reactions in Sediment Pore Waters, and Role in Metal Cycling,
W83-03699 2H

Levels of Nonpolar Organic Compounds in the Columbia Generating Station Cooling Pond,
W83-03717 5C

WYOMING UNIV., LARAMIE. COLL. OF AGRICULTURE.
Evapotranspiration From Heterogeneous Mountain Meadows,
W83-03684 2D

WYOMING UNIV., LARAMIE. WATER RESOURCES RESEARCH INST.
The Snowy Range Observatory: Climatological and Streamflow Data Report 1982,
W83-03675 7C

ZWECKVERBAND LANDESWASSERVERSORGUNG, STUTTGART (GERMANY, F.R.).
Development of Suitable Closure Specifications for Remote Controlled Ball Valves to Limit Water Hammer in Pipelines of the Zweckverband Landeswasserversorgung Stuttgart (Entwicklung Geeigneter Schliessgesetze Zur Druckstossbegranzung Bei Ferngesteuerten Kugelschiebern In Den Fernwasserleitung Des Zweckverbandes Landeswasserversorgung Stuttgart),
W83-03524 8C

ACCESSION NUMBER INDEX

W83-03501 5G
W83-03502 5F
W83-03503 2F
W83-03504 5C
W83-03505 5E
W83-03506 5D
W83-03507 5F
W83-03508 5B
W83-03509 5D
W83-03510 5C
W83-03511 2K
W83-03512 2K
W83-03513 5A
W83-03514 2K
W83-03515 5G
W83-03516 5G
W83-03517 5D
W83-03518 8A
W83-03519 5D
W83-03520 5B
W83-03521 3E
W83-03522 5F
W83-03523 5F
W83-03524 8C
W83-03525 2E
W83-03526 8A
W83-03527 7B
W83-03528 5B
W83-03529 7B
W83-03530 6C
W83-03531 5D
W83-03532 5C
W83-03533 5D
W83-03534 5D
W83-03535 5D
W83-03536 5B
W83-03537 5D
W83-03538 5D
W83-03539 8C
W83-03540 5B
W83-03541 5B
W83-03542 2F
W83-03543 5C
W83-03544 5B
W83-03545 5D
W83-03546 5D
W83-03547 5D
W83-03548 5F
W83-03549 5D
W83-03550 5D
W83-03551 5A
W83-03552 5C
W83-03553 5B
W83-03554 5A
W83-03555 5B
W83-03556 5D
W83-03557 5A
W83-03558 3F
W83-03559 6E
W83-03560 2D
W83-03561 2K
W83-03562 4B
W83-03563 5E
W83-03564 5F
W83-03565 2K
W83-03566 5C
W83-03567 5A
W83-03568 5F
W83-03569 5D
W83-03570 5D
W83-03571 5D
W83-03572 5D
W83-03573 5D
W83-03574 5D
W83-03575 5D
W83-03576 5D
W83-03577 5G
W83-03578 2F
W83-03579 5A
W83-03580 6A
W83-03581 5E
W83-03582 5A
W83-03583 5D
W83-03584 5G
W83-03585 2F
W83-03586 8C
W83-03587 6B
W83-03588 5B
W83-03589 3C
W83-03590 5B
W83-03591 5A
W83-03592 6B
W83-03593 5A
W83-03594 6E
W83-03595 7B
W83-03596 6A
W83-03597 5B
W83-03598 7C
W83-03599 5B
W83-03600 9D
W83-03601 6B
W83-03602 5A
W83-03603 5D
W83-03604 5D
W83-03605 2F
W83-03606 6A
W83-03607 5B
W83-03608 8B
W83-03609 5B
W83-03610 4C
W83-03611 2E
W83-03612 3B
W83-03613 1B
W83-03614 6F
W83-03615 3C
W83-03616 4A
W83-03617 5B
W83-03618 3C
W83-03619 5B
W83-03620 2L
W83-03621 2L
W83-03622 3A
W83-03623 5C
W83-03624 5F
W83-03625 5F
W83-03626 5G
W83-03627 5G
W83-03628 5G
W83-03629 5G
W83-03630 6F
W83-03631 7B
W83-03632 5D
W83-03633 5E
W83-03634 5G
W83-03635 6E
W83-03636 5B
W83-03637 6B
W83-03638 5D
W83-03639 6D
W83-03640 6D
W83-03641 8B
W83-03642 8G
W83-03643 8G
W83-03644 8B
W83-03645 6G
W83-03646 4A
W83-03647 5D
W83-03648 6B
W83-03649 6C
W83-03650 8G
W83-03651 8D
W83-03652 8B
W83-03653 8B
W83-03654 5F
W83-03655 5D
W83-03656 2E
W83-03657 8D
W83-03658 3D
W83-03659 5E
W83-03660 5E
W83-03661 5E
W83-03662 6D
W83-03663 2G
W83-03664 5D
W83-03665 5D
W83-03666 5D
W83-03667 6G
W83-03668 2F
W83-03669 3F
W83-03670 2F
W83-03671 8G
W83-03672 5B
W83-03673 4B
W83-03674 2K
W83-03675 7C
W83-03676 6G
W83-03677 5B
W83-03678 3A
W83-03679 5D
W83-03680 4A
W83-03681 8A
W83-03682 5B
W83-03683 5F
W83-03684 2D
W83-03685 8I
W83-03686 4D
W83-03687 2I
W83-03688 5B
W83-03689 6C
W83-03690 5B
W83-03691 6G
W83-03692 6E
W83-03693 2L
W83-03694 2L
W83-03695 4D
W83-03696 4A
W83-03697 5D
W83-03698 5C
W83-03699 2H
W83-03700 5C
W83-03701 6F
W83-03702 6F
W83-03703 2F
W83-03704 4B
W83-03705 5B
W83-03706 5D
W83-03707 2K
W83-03708 2L
W83-03709 5C
W83-03710 5D
W83-03711 5B
W83-03712 5B
W83-03713 5C
W83-03714 5B
W83-03715 8C
W83-03716 3D
W83-03717 5C
W83-03718 5B
W83-03719 5A
W83-03720 6E
W83-03721 4B
W83-03722 6D
W83-03723 2H
W83-03724 2H
W83-03725 5F
W83-03726 5A
W83-03727 5D
W83-03728 2L
W83-03729 3F
W83-03730 10C
W83-03731 5B
W83-03732 2J
W83-03733 2F
W83-03734 6D
W83-03735 5D
W83-03736 2G
W83-03737 5D
W83-03738 5B
W83-03739 5B
W83-03740 5A
W83-03741 5D
W83-03742 8C
W83-03743 5B
W83-03744 5B
W83-03745 5B
W83-03746 5D
W83-03747 5D
W83-03748 5D
W83-03749 2G
W83-03750 2J
W83-03751 2G
W83-03752 3B
W83-03753 3F
W83-03754 2G
W83-03755 2G
W83-03756 2H
W83-03757 2F
W83-03758 4B
W83-03759 8B
W83-03760 5B
W83-03761 8A
W83-03762 5A
W83-03763 5D
W83-03764 5F
W83-03765 6F
W83-03766 7B
W83-03767 3F
W83-03768 2G
W83-03769 2G
W83-03770 7B
W83-03771 2F
W83-03772 3B
W83-03773 3F
W83-03774 2I
W83-03775 5B
W83-03776 2E
W83-03777 2G
W83-03778 2A
W83-03779 6E
W83-03780 2G
W83-03781 2G
W83-03782 2G
W83-03783 2D
W83-03784 5D
W83-03785 5B
W83-03786 2B
W83-03787 2B
W83-03788 2B
W83-03789 3F
W83-03790 5E
W83-03791 5D
W83-03792 5D
W83-03793 5D
W83-03794 5A
W83-03795 5B
W83-03796 7B
W83-03797 5C
W83-03798 5A
W83-03799 5F
W83-03800 2B
W83-03801 7B
W83-03802 5B
W83-03803 5B
W83-03804 5B
W83-03805 2J
W83-03806 7B
W83-03807 2E
W83-03808 2E
W83-03809 2K
W83-03810 3B
W83-03811 6F
W83-03812 5E
W83-03813 5D
W83-03814 5A
W83-03815 2H
W83-03816 4B
W83-03817 2G
W83-03818 2A
W83-03819 5E
W83-03820 5B
W83-03821 6D
W83-03822 2A
W83-03823 5D
W83-03824 6G
W83-03825 5D
W83-03826 5D
W83-03827 5D
W83-03828 5D
W83-03829 5B
W83-03830 8B
W83-03831 6F
W83-03832 2J
W83-03833 2J
W83-03834 5G
W83-03835 6D
W83-03836 5B

W83-03837

W83-03837 5F
W83-03838 2H
W83-03839 5G
W83-03840 5D
W83-03841 5B
W83-03842 6D
W83-03843 5G
W83-03844 5A
W83-03845 5G
W83-03846 5G
W83-03847 5G
W83-03848 5G
W83-03849 5G
W83-03850 2A

Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

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SELECTED WATER RESOURCES ABSTRACTS

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VOLUME 16, NUMBER 12
DECEMBER 1983

W83-03851 -- W83-04200
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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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VOLUME 16, NUMBER 12
DECEMBER 1983

W83-03851 -- W83-04200

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
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U.S. Geological Survey, MS 421
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CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

MERIDIONAL VARIATION OF WATER BALANCE IN RAJASTHAN STATE,
Andhra Univ., Waltair (India). Dept. of Meteorology and Oceanography.
A. R. Subramaniam, and G. S. L. H. V. Prasada Rao.
Annals of Arid Zone, Vol 19, No 1 and 2, p 51-57, March-June, 1980. 4 Fig, 1 Tab, 2 Ref.

Descriptors: *Hydrologic budget, *Arid lands, *Rainfall distributuion, Droughts, Longitude, Semiarid lands, Climatology, Rajasthan, *India.

The variation of water balance with longitude (70 to 78 degrees E) in the arid to semi-arid state of Rajasthan, India, was evident after an analysis of data from 1901-1977. Potential evaporation is constant in all longitudes for a given year. Precipitation increases from west to east. Water deficiency deceases toward the east. The aridity index decreases gradually from west to east. The west has high aridity and low droughtiness, whereas the east has low aridity and high droughtiness. This is caused by the higher variability of rainfall in the east. Soil moisture storage is zero in the west and increases sharply at 75 degrees E. For the state as a whole, the mean water deficiencies were 986 mm for a normal year, 760 mm for the wettest year (1956) and 1109 mm for the driest year (1966). (Cassar-FRC)
W83-03881

SOME HYDRO-HORTICULTURAL RELATIONS IN A BER ORCHARD (ZIZYPHUS MAURITIANA LAMK.),
Central Arid Zone Research Inst., Jodhpur (India).
R. C. Yadav, K. D. Sharma, H. P. Singh, and O. P. Pareek.
Annals of Arid Zone, Vol 19, No 3, p 297-300, September, 1980. 2 Tab, 4 Ref.

Descriptors: *Orchards, *Runoff, *Slopes, Ber, Rainfall-runoff relationships, *India, Jodhpur.

Rainfall-runoff relationships were studied for 3 years, 1975-77, in a ber (jujube) orchard in India, using 15 combinations of 3 slopes (0.5, 5 and 10%) and 5 lengths of run (5.12 to 14.5 m). Mean seasonal runoff (July to September) from the 3.0 m long natural slope control plot was 9.1 mm per year (3% of rainfall). Mean seasonal runoffs for the sloped plots were: 0.5% plot, 57.7 mm (19.3% of rainfall); 5.0% plot, 120.2 mm (40.1% of rainfall); and 10.0% plot, 99.5 mm (33.2% of rainfall). Runoff, highest in the slopes with 5.12 and 7.0 m lengths, decreased to a minimum in the longest runs. Statistical analysis of the data revealed that 86% of the variation in the runoff was attributable to rainfall. The threshold quantity of rainfall required to produce runoff was 2.5 mm. The average tree height, linear growth, and yield per plot were highly correlated with runoff concentration. (Cassar-FRC)
W83-03882

AN INFILTRATION BASED RUNOFF MODEL FOR A STANDARDIZED 24-HOUR RAINFALL,
Agricultural Research Service, Beltsville, MD.
D. L. Brakensiek, and W. J. Rawls.
Transactions of the ASAE, Vol 25, No 6, p 1607-1611, November/December, 1982. 1 Fig, 4 Tab, 10 Ref.

Descriptors: *Rainfall-runoff relationships, *Rainfall infiltration, *Mathematical models, Rainfall distribution, Runoff volume, Runoff rates, Runoff forecasting, Soil texture, Soil water.

The application of the Green and Ampt infiltration equation to a standardized 24-hour rainfall distribution is described. Procedures for predicting surface runoff amount and duration are developed and illustrated through an example using the Soil Conservation Service (SCS) Type II, 24-hour rainfall distribution. Tabulated values are presented for soil infiltration parameters as a function of soil texture. The example demonstrates the application of the procedure to a given soil texture, antecedent soil water condition, 24-hour rainfall total, and a 24-hour rainfall distribution with the SCS Type II distribution. Other distributions could be used, with the constraint that they are successively monotonic increasing and then decreasing. The predicted runoff amounts and durations could be used to make runoff peak rate estimates. This infiltration approach provides an improved framework for evaluating the effects of land use and practices on runoff amounts and duration. (Carroll-FRC)
W83-03961

PREDICTION OF RAINFALL EXCESS AND SOIL WATER FLUX FROM VARIABLE STORMS ON LAYERED FIELD SOILS,
New South Wales Univ., Kensington (Australia).
A. W. Thomas, R. R. Bruce, and A. A. Curtis.
Transactions of the ASAE, Vol 25, No 6, p 1589-1596, November/December, 1982. 10 Fig, 6 Tab, 15 Ref.

Descriptors: *Rainfall-runoff relationships, *Rainfall infiltration, *Soil water, Mathematical models, Simulation analysis, Storm runoff, Rainfall rate.

A variable rainfall infiltration model derived from soil water flow theory was used to examine the effects of variable rainfall patterns, including non-rain periods, on rainfall excess and soil water fluxes in a layered soil; the effects of different time increments for averaging rainfall input on rainfall excess and soil water fluxes; and the effects of soil profile modification that may conceptually be attributed to water erosion. The effect of antecedent soil water conditions was also studied. The model was applied to a soil profile representing a watershed slope site that had experienced significant erosion and to a profile representing a drainageway where deposition had occurred. The model partitioned rainfall at the soil surface into rainfall excess and infiltrated waters, of which part became stored in profile, with the balance transported to a deeper depth. Regardless of the rainfall pattern, the initial soil water affected the computed rainfall excess significantly, although the effects were more striking for the drainageway profile than for the slope profile. This study showed quantitatively that rainfall excess tended to increase as the centroid of rainfall mass shifted towards the end of the storm, with the trend being much stronger for the drier antecedent soil water condition than for the wetter condition. The effects of time increments for averaging rainfall inputs were much more significant for the drainageway profile than for the slope profile. The storm interruptions increased rainfall capture to a greater degree when the majority of the storm occurred before the interruptions. The soil water flux through a plane in a soil profile was a product of the hydraulic characteristics of all soil layers and the historic and current state of the flow system. (Carroll-FRC)
W83-03962

MODIFICATION OF THE TANGBORN SHORT-TERM HYDROMETEOROLOGICAL MODEL, WITH TRIAL RESULTS FROM THE BAKER RIVER BASIN, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
M. R. Karlinger, and J. D. Wilson.
Open-File Report 81-694 (WRI), 1981. 63 p, 3 Fig, 1 Tab, 3 Ref, 2 Append.

Descriptors: *Computer models, *River basins, *Snowmelt, *Runoff forecasting, Estimating, Hydrologic data, *Washington, Baker River basin.

A modification of the short-term hydrometeorological model (Tangborn, 1978) for estimating river-basin snowmelt runoff is presented. A multiple-linear regression replaces a nonlinear-regression scheme to correct for temperature effects of snowmelt runoff. Results using Baker River basin, Washington, data indicate that model performance is improved by the modification in a majority of applications and, additionally, use of the model is simplified and computer time is reduced. (USGS)
W83-04009

ASSESSMENT OF HYDROLOGIC CONDITIONS IN POTENTIAL COAL-LEASE TRACTS IN THE WARRIOR COAL FIELD, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
C. Puente, J. G. Newton, and R. H. Bingham.
Open-File Report 81-540, 1982. 43 p, 13 Fig, 5 Tab, 11 Ref.

Descriptors: *Groundwater, *Surface water, *Water quality, *Mine wastes, Coal mining, Mine drainage, Groundwater availability, Streamflow, Flow characteristics, Regression analysis, *Alabama, Warrior Coal Field.

Assessing the hydrology of potential Federal coal-lease tracts, because of their dissemination and limited data, requires some predictive capability. Four tracts assessed were located in the outcrop of three coal groups and of other relatively impermeable rocks in the Pottsville Formation. Physical settings of the tracts and most other areas in the Warrior coal field are similar. This results in similar ground-water and surface-water characteristics, in similar impacts resulting from surface coal mining, and in maximizing the transfer-ability of data. Assessments of the tracts reflected the small storage of water in underlying rocks and corresponding low yields to wells and to the base flow of streams. Ground water and surface water in undisturbed areas are generally of good quality. Some subbasins in the tracts have already been impacted by mining. Estimates of streamflow characteristics and the availability and quality of ground water in the tracts were made using available methodology, or assessments based on local and regional data. Estimates of the degree mineralization of surface-water were made using methodology developed from other coal hydrology work. Climatic, physiographic, hydrologic, and land-use data were analyzed by regressions to derive relations for assessing water quality in streams draining mined and unmined areas. In this approach, an equation was derived to estimate specific conductance. Additional equations, based on relations between specific conductance and other constituents, allow estimates of mine drainage indicators such as hardness, dissolved solids, and sulfate. Hydrologic assessments of the tracts, based on limited verification data, proved to be reasonably accurate. (USGS)
W83-04010

PREDICTING DISCHARGE ON UNGAGED STREAMS FROM RAINFALL MEASUREMENTS IN SOUTHERN ARIZONA,
Arizona Water Resources Research Center, Tucson.
E. S. Simpson, and D. C. Chery.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105352, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, July 1983. 47 p, 25 Fig, 2 Tab, 17 Ref. OWRT A-077-ARIZ(2), 14-34-001-7005/7006.

Descriptors: *Parametric hydrology, *Hydrologic models, Computer models, *Streamflow forecasting, Runoff forecasting, *Arizona, Rainfall intensity, Model studies.

Recent developments in the numerical solution of the governing partial differential equations for overland and channel flow (represented by sets of intersecting planes) should make possible models which predict runoff from ungaged streams. However, these models (physically based models) are complex and require much computer time. Parametric models exist which have the advantage of being relatively simple, and once calibrated may be used efficiently and inexpensively. This study developed a procedure for calibrating a parametric model against physically based model utilizing base areas of one acre and one square mile, with the expectation that base areas can be combined to model real watersheds. Simulation experiments with the physically based model showed that, for the one-acre base area, the dominant parameters relate to the slope and friction of the planes, whereas for the square-mile area, the dominant parameters relate to the channel properties. The simple model-fitting parameters were the cell stor-

age ratio, K, for the one-acre area, and K plus a lag factor, L, for the square-mile area. These parameters decreased more or less exponentially with increasing rainfall intensity and with changes in the physical parameters that produced high peaks and fast runoff.
W83-04137

MODELING AND ANALYSIS OF HYDRAULIC INTERCHANGE OF SURFACE AND GROUNDWATER,
Nevada Univ. System, Reno. Desert Research Inst.
A. B. Cunningham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105436, Price codes: A05 in paper copy, A01 in microfiche. Publication No H-W34, July 1977. 89 p, 31 Fig, 5 Tab, 41 Ref. OWRT B-078-NEV(3), 14-31-0001-5089.

Descriptors: *Hydrologic models, *Groundwater movement, Base flow, Groundwater storage, *Sensitivity analysis, Truckee River, Hydraulic interchange, *Nevada, Model studies, *Surface-groundwater relations.

A technique for modeling the hydraulic interchange between surface and groundwater in an unconfined aquifer-river system has been developed. Modeling procedure consists of simultaneous solution of the Saint Venant equations for one dimensional open channel flow and the Boussinesq equation descriptive of two dimensional transient groundwater flow, coupled by an expression for flow through a channel wetted perimeter. Gelerkin finite element technique was utilized in the numerical solution algorithm. Evaluation of model predictive capability was accomplished in three interrelated phases: 1) parameter sensitivity investigations provided information regarding the accuracy to which individual system parameters must be measured in order to insure successful model operaion; 2) examination of predictive uncertainty indicated generally good overall predictive capability and fair to good prediction of extreme high and low river stage and groundwater table elevations, with predictive reliability decreasing with distance from the river channel; and 3) uniqueness of solution investigation provided insight into the reliability associated with extrapolation of model results beyond the limits of observed field measurements.
W83-04145

USE OF DIGITIZED RADAR AND MICROCOMPUTERS TO FORECAST LOCAL FLOODS AND IRRIGATION NEEDS,
Clemson Univ., SC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W83-04158

CRITICAL DURATION ANALYSIS AND PARAMETER ESTIMATION IN ILLUDAS,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
H. R. Lemmer, and A. R. Rao.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105618, Price codes: A11 in paper copy, A01 in microfiche. Technical Report No 153, June 1983. 227 p, 44 Fig, 23 Tab, 30 Ref. 3 Append. OWRT C-00090-U(No 0498)(1).

Descriptors: *Urban hydrology, *Urban runoff, *Rainfall distribution, Rainfall rate, *Parametric hydrology, Rainfall-runoff relationships, Computer models, Storm runoff, Urban watersheds, Kentucky, Ohio, Indiana, Louisville, Cincinnati, West Lafayette.

Storm durations are often arbitrarily selected for designing urban drainage systems. The first objective of this study is to develop guidelines for selecting optimal storm durations. The second objective deals with the parameter estimation in rainfall-runoff models. The urban rainfall-runoff model ILLUDAS was used to obtain the maximum runoff rate for a given set of parameters. The maximum runoff rates are studied to obtain the duration that yields the largest runoff rate which is called the critical duration. The sensitivity of the model parameters on the critical duration was studied. Data from the First Street Watershed, Louisville, KY., Mount Washington Watershed, Cincinnati, OH., and Bar Barry Hieghts, West Lafayette, IN. were used in the analysis. The two-stage parameter estimation procedure based on a maximum likelihood estimator and a Bayesian formulation (developed by Soroosian in 1981) was applied to observed rainfall and runoff data from the Mount Washington watershed. The parameters obtained by this procedure yielded runoff estimates which were closer to the observed values than the parameter estimates and runoff computed from the simple least squares parameter estimation procedure.
W83-04163

2B. Precipitation

AGRICULTURAL METEOROLOGY IN CHINA,
Nebraska Univ.-Lincoln. Center for Agricultural Meteorology and Climatology.
N. J. Rosenberg.
Bulletin of the American Meteorological Society, Vol 63, No 3, p 250-257, March, 1982. 4 Fig, 2 Ref.

Descriptors: *Farming, *Meteorology, Climatology, *China, Scientific personnel, Agriculture, Agricultural engineering, Institutions, Research facilities, Planning.

The facilities, studies and research programs at various institutions in China are described, and the scientific work in the fields of agricultural meteorology and climatology is evaluated. The author visited the following institutions: Beijing University, Beijing Agricultural University, Beijing Academy of Agricultural Sciences, the Institute of Geography, the Chinese Academy of Agricultural Sciences, the Central Meteorological Bureau, the Meteorological Institute in Nanjing, the Institute of Plant Physiology in Shanghai, and the Desert Research Institute in Lanzhou. The work at these institutions ranged from simple and repetitive data organization and summarization to quite advanced analysis of climatic zonation and productivity potentials. Most of the work lies between the two extremes, involving computations of various standard indices of potential evapotranspiration or thermal conditions based on heat units. Some interesting multiple-cropping schemes involving intercropping and relay cropping were noted. While the instruments the Chinese were using in their scientific work were frequently copies of western, Russian or Japanese equipment, many workers were unaware of systematic errors in the measurements they were making. This problem appeared to represent the greatest area where aid in agricultural meteorology was needed. Most of the institutions visited by the author have made arrangements for one or two people to study abroad for advanced studies in agrometeorology. (Baker-FRC)
W83-03851

ON SOME HYDROMETEOROLOGICAL ASPECTS OF HEAVY RAINFALL DISTRIBUTION OVER THE PRINCIPAL ARID ZONE OF RAJASTHAN,
Indian Inst. of Tropical Meteorology, Poona.
P. R. Rakhecha, and O. N. Dhar.
Annals of Arid Zone, Vol 19, No 4, p 413-420, December, 1980. 2 Fig, 5 Tab, 5 Ref.

Descriptors: *Rainfall distribution, *Probable maximum precipitation, *Storms, Hydrometeorology, *India, Arid lands, Rainfall intensity, Rainstorms, Areal Precipiation, Local precipitation, Precipitation, Floods, Design storms, Rajasthan.

Distribution of heavy rainfall ovver western Rajasthan in India was analyzed to provide data for managing water resources. In this arid area single-day rainfalls (heaviest recorded, 51.2 cm at Sanchore on September 16, 1893) often exceed 25 cm and sometimes exceed yearly average precipitation. The largest rainstorms with respect to depth-area-duration are listed. The most severe was August 13-19, 1973, when about 32 billion cu m of water was generated. A table lists rainfall magnitudes for 40 selected stations for a one-day rainfall for return periods of 2 to 100 years. Another table lists the highest one-day rainfalls and their return periods (<1000 years in 2 cases) for 18 heavy-rainfall stations. One-day probable maximum precipitation estimates, varying from 30 to 90 cm, are given on a map. (Cassar-FRC)
W83-03872

CLIMATIC STUDY OF WATER BALANCE, ARIDITY, AND DROUGHTS IN RAJASTHAN STATE,
Andhra Univ., Waltair (India). Dept. of Meteorology and Oceanography.
A. R. Subramaniam, and G. S. L. H. V. Prasada Rao.
Annals of Arid Zone, Vol 19, No 4, p 371-377, December, 1980. 4 Fig, 4 Tab, 3 Ref.

Descriptors: *Droughts, *Arid lands, *Hydrologic budget, Semiarid lands, Rajasthan, *India, Climatology, Precipitation, Rainfall.

The water balances of three stations of Rajasthan state in India were studied for the years 1969-1976. They represented arid (Bikaner), semi-arid (Jaipur), and dry sub-humid (Jhalawar) climates. The driest year during this period was 1969 in Bikaner and Jaipur and 1974 in Jhalawar. Least dry years were 1975 for Bikaner and Jaipur and 1969 for Jhalawar. Aridity trends showed that Bikaner and Jaipur are decreasing in aridity and Jahalawar is increasing in aridity. Although each station experienced 4 droughts in the study period, those at Bikaner and Jaipur were much more severe than at Jahalawar. (Cassar-FRC)
W83-03884

PRECIPITATION-DURATION-FREQUENCY RELATIONSHIPS FOR A MOUNTAINOUS WATERSHED IN SOUTHWEST IDAHO,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. L. Hanson, and R. P. Morris.
Transactions of the ASAE, Vol 25, No 6, p 1637-1640, November/December, 1982. 4 Fig, 3 Tab, 12 Ref.

Descriptors: *Precipitation, *Watersheds, *Storms, Thunderstorms, Snow, Design storms, Seasonal distribution, Elevation, Comparison studies, *Idaho, Reynolds Creek watershed.

A procedure has been developed that can be used to estimate the maximum precipitation amounts for durations of 15 minutes to 24 hours and return periods of 2 to 50 years that are associated with summer, winter, and annual influences and with elevation changes. The precipitation data were obtained from the precipitation gage network on the Reynolds Creek Experimental Watershed in southwest Idaho. Summer maximum precipitation amounts on the watershed were found to be caused primarily by summer thunderstorms at the lower elevations (1200 meters) for durations of 15 minutes to 2 hours, while both summer and winter storms contributed to the maximum amounts for durations greater than 2 hours. At the higher elevations (2100 meters), the annual amounts for maximum 15- and 30-minute durations were caused by both summer thunderstorms and winter storms. Just over 50% of the maximum values for durations of 1 or 2 hours were caused by winter storms, while winter precipitation accounted for about 90% of the annual maximum values for durations of 6 hours or longer. The 6- and 24-hour duration precipitation amounts interpolated from NOAA ATLAS 2 for return periods of 2, 5, 10, 25, and 50 years were about 13% lower than computed values at the 1200 meter elevation on the experimental watershed. At the 2100 meter elevation, 6-hour duration precipitation amounts interpolated from NOAA ATLAS 2 were about 42% less than measured values for the 24-hour durations, and 50% of the measured values or less. The study results suggests that local climatic information needs to be taken into account when published data are used for engineering design projects. (Carroll-FRC)
W83-03974

VARIATIONS IN MONTHLY PRECIPITATION OVER NORTH CAROLINA,
North Carolina State Univ. at Raleigh.
B. K. Eder, J. M. Davis, and P. J. Robinson.
Water Resources Research Institute Report No 185, January 1983. 46 p, 16 Fig, 1 Tab, 3 Append.

Descriptors: *Precipitation, *Local precipitation, *Precipitation rate, *Precipitation intensity, Atmospheric precipitation, Rain gages, Rainfall, Snow, Probable maximum precipitation, Statistical analysis, Histograms, Computers, Rainfall distribution.

In 1973 the WRRI of the University of North Carolina published a technical report entitled 'Precipitation Variability Over North Carolina' by Saucier, Weber, and Bayne. This revised version of that report is intended to update precipitation maps to reflect the 1951-1980 normal period, and to be in a form useful to the general public and to technicians. The spatial and temporal variability of precipitation over North Carolina is examined through a statistical analysis of monthly normal precipitation data. Tables and maps derived from these data provide monthly precipitation means and standard deviations for 85 locations. The precipitation distribution is partially controlled by the geographic position of the state relative to the global atmospheric circulation system. Superimposed on this system are physiographic controls imposed by the Appalachian Mountains in the western part of the state and the Atlantic ocean to the east. The resulting precipitation patterns are quite complex. The annual precipitation has a summer maximum and a winter minimum. Alternating rainy and fair weather caused by atmospheric circulation causes precipitation that is derived mainly from cyclonic storms, which also create major elements of variability and unpredictability. Spring and autumn minima in rainfall are greatly affected by global atmospheric circulation which shift northward and southward in an annual cycle. Resulting precipitation peaks annually occur in February-March and July-August; minima generally occur in May-June and September-October. (Garrison-Omniplan)
W83-03992

DISCUSSION-SEASONALITY OF FLOODING AND THE ASSESSMENT OF SEASONAL FLOOD RISK,
D. R. Archer.
Proceedings of the Institution of Civil Engineers, Part 2, Research and Theory, Vol 73, No 3, p 683-685, September, 1982. 8 Fig, 7 Ref.

Descriptors: *Floods, *Seasonal variations, *Predicting, Rainfall-runoff relationships, Rainfall, Altitude, Tropical regions, Probability distribution.

In this discussion of a paper by D. R. Archer, published in Proceedings of the Institution of Civil Engineers, Part 2, Vol 71, p 1023-1035, December, 1981, the current author states that while there has been a general tendency to assume a simple relationship of rainfall to altitude, studies at present indicated a much more complex relationship varying with both duration and probability. Monthly median rainfall exhibited the strongest positive correlation of depth with altitude. At the other extreme, maximum daily rainfall approaching the physical upper limit exhibits a negative correlation with altitude. The current author suggests avoiding use of the term 'mean annual flood', for, if it means the average value of annual maximum floods, it is very sensitive because of periodicity, particularly in the case of small samples. (Baker-FRC)
W83-04019

2C. Snow, Ice, and Frost

FLOW CONVEYANCE WITH ICE COVER FOR THE NASHWAAK RIVER, N.B.,
New Brunswick Dept. of the Environment, Fredericton. Water Resources Branch.
For primary bibliographic entry see Field 2E.
W83-03853

GLACIERS AS A WATER RESOURCE,
M. F. Meier, and E. F. Roots.
Nature and Resources, Vol 18, No 3, p 7-14, July/September, 1982. 6 Fig, 1 Tab.

Descriptors: Water resources development, *Glaciers, *Snow, *Ice, Water supply development, Water supply, *Data collections, Water demand, Runoff.

Programs of the International Hydrological Program are explained as they attempt to clarify our understanding of the interrelations between snow and ice, climate and water supply. While it is obvious that only some countries are located in cold regions or near high mountains in which they would have an interest in snow-and-ice water resources, it is hoped that glaciological programs such as these will assist these countries in using information and know-how by which they can move their frozen water reserves. Glaciers act as buffers and regulate the runoff from high mountains. Glaciers may also be sensitive indicators of climate, directly. Glacier ice balances may be measured over large areas of the world from aircraft or satellite. Climated history can be studied by observing the annual sequences in ice cores. Specific programs of the IHP have led to the production of training manuals especially for individuals involved in snow and ice hydrology in developing countries; held training courses on snow-and-ice measurements and on snow-avalanche hazard in Sweden; developed a World Glacier Inventory Program; developed a scientific program of combined heat, ice, and water balance studies at representative glacier basins; established a permanent service on the fluctuations of glaciers; sponsored or co-sponsored symposia on many aspects of snow-and-ice science; developed procedures, bibliographies and a manual for prediction of glacier runoff; developed a major new program on large-scale snow studies; and cooperated in the preparation of the forthcoming Satellite Image Atlas of Glaciers and the Atlas of World Snow and Ice Resources. (Baker-FRC)
W83-04021

2D. Evaporation and Transpiration

AN OBSERVATIONAL-DATA BASED EVAPOTRANSPIRATION FUNCTION FOR GENERAL CIRCULATION MODELS,
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
Y. C. Sud, and M. J. Fennessy.
Atmosphere-Ocean, Vol 20, No 4, p 301-316, 1982. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Evapotranspiration, *Model studies, Circulation, Soil moisture, Moisture availability, Soil water.

Nappo's formulation of the moisture availability function was used to derive the beta function of the form employed in the evapotranspiration calculations of various general circulation models (GCMs). The derivation was based on the simulated evapotranspiration in the last 31 days of a 47-day integration of the GLAS climate model. For each land grid point two temperatures were used, one corresponding to the saturated ground and the other to the naturally dry ground. The beta function, which related actual evapotranspiration to the potential evapotranspiration from saturated ground at the actual temperature of the ground, was then obtained by the best fit. The resulting beta function is small at low soil moisture values. This reduces the excessive evapotranspiration from nearly dry ground in summertime. The smoother asymptotic shape of the beta curve at high soil moisture values mitigates the spurious effect of the stronger diurnal temperature oscillation on actual evapotranspiration. The new values of beta are generally lower than those previously used in the GLAS GCM, thereby reducing evapotranspiration over land. The global evapotranspiration fields obtained with the new beta function are virtually identical to those obtained by using two ground temperatures, which are themselves quite realistic. (Baker-FRC)
W83-04116

2E. Streamflow and Runoff

FLOW CONVEYANCE WITH ICE COVER FOR THE NASHWAAK RIVER, N.B.,
New Brunswick Dept. of the Environment, Fredericton. Water Resources Branch.
B. Burrell, and K. S. Davar.
Canadian Journal of Civil Engineering, Vol 9, No 4, p 674-677, December, 1982. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Ice cover, *Channel flow, *Roughness coefficient, Frazil ice, Flow characteristics, Flow velocity, Open-channel flow, River flow, Nashwaak River, *New Brunswick, Water surface profiles, Cross-sections, Slush, Anchor ice, Closed-conduit flow, Hydraulic properties.

Flow conveyance characteristics were studied in a 460 m stretch of the Nashwaak River, New Brunswick, during ice cover (January-March, 1980) and open water (April-July, 1979). Effective flow section (waterway opening under the ice cover), water surface elevation, and discharge were determined. Average cross-sectional properties in open water months were: discharge, 7-165 cu m per sec; mean velocity, 0.19-1.30 m per sec; area, 37-125 sq m; and hydraulic radius, 0.40-1.28 m. Under ice cover these values were: discharge, 4-24 cu m per sec; mean velocity, 0.14-0.34 m per sec; area, 26-75 sq m; and hydraulic radius, 0.18-0.43 m. Water surface slopes were greater during ice cover conditions than in open water. Manning resistance coefficients are expected to be lower under ice cover, but results of this study were complicated by slush and frazil ice, which produced great variability. (Cassar-FRC)
W83-03853

A CONTINUUM MECHANICS APPROACH TO STREAMFLOW MODELING,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, S. N. Prasad, and L. Ubertini.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265041, Price codes: A04 in paper copy, A01 in microfiche.
Louisiana Water Resources Research Institute Completion Report, July 1983. 49 p, 6 Fig, 100 Ref. OWRT A-058-LA(2), 14-34-0001-2120.

Descriptors: *Hydrologic modeling, *Streamflow synthesis, Ungaged basins, *Surface flow, *Unsaturated flow, *Saturated flow, Free boundary problems, Dynamic interactions, Ephemeral streams, Infiltration, Soil moisture, Overland flow.

This study surveys modeling of streamflow for a given rainfall event, and develops a framework for an approach based on principles of mathematical physics. This approach treats streamflow as a continuum and takes into account dynamic interactions between three modes of flow: (1) surface flow, (2) unsaturated flow, and (3) saturated flow. In this manner, two independent areas of study blend together: (1) soil water and (2) hydraulics of runoff. Surface flow consists of both overland flow and channel flow. Overland flow interacts strongly with movement of moisture beneath the soil surface. Surface flow is described by a boundary value problem involving partial differential equations of hyperbolic type. This problem gives rise to a free boundary problem as a result of dynamic interactions between surface flow and movement of moisture in the porous medium. The porous medium may be partly unsaturated and partly saturated. The movement of moisture and its distribution may give rise to return flow, interflow and baseflow. The moisture movement is governed by partial differential equations of parabolic type in the unsaturated zone and by partial differential equations of elliptic type in the saturated zone. These two zones have strong dynamic interactions and the boundaries defining their interactions are free boundaries. Interflow and baseflow are described by boundary value problems involving these equations and free boundaries.
W83-03996

TECHNIQUES FOR ESTIMATING THE MAGNITUDE AND FREQUENCY OF FLOODS IN

Group 2E—Streamflow and Runoff

THE DALLAS-FORT WORTH METROPOLITAN AREA, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
L. F. Land, E. E. Schroeder, and B. B. Hampton.
Water-Resources Investigations 82-18, May 1982. 55 p, 24 Fig, 10 Tab, 15 Ref.

Descriptors: *Flood forecasting, *Flood frequency, *Flood discharge, *Regression analysis, Floods, Hydrologic models, Rainfall-runoff relationships, Flood recurrence interval, Flood peak, Urbanization, Hydrologic data, *Texas, Dallas-Fort Worth metropolitan area.

Equations for predicting the magnitude and frequency of floods in the Dallas-Fort Worth metropolitan area were developed from recorded data from streams with drainage areas ranging in size from 1.25 to 66.4 square miles. The U. S. Geological Survey urban rainfall-runoff model was used to generate long-term flood-discharge record for gaged streams in the area. Simulated and recorded annual-peak data were subjected independently to log Pearson III frequency analyses. The results were weighted to determine appropriate discharges for selected 2-, 5-, 10-, 25-, 50-, and 100-year recurrence intervals. These T-year values were then used as the dependent variables in a multiple regression analysis. The independent variable determined to be statistically significant and retained in the resulting equations were drainage area and an urbanization index that expresses the degree of urban development. Analysis of the results shows that a land-use change from rural to fully urbanized is accompanied by a 180% increase in discharge of a flood with a 5-year recurrence interval and about 100% increase in discharge of a flood with a 100-year recurrence interval. (USGS)
W83-04013

DISCUSSION-SEASONALITY OF FLOODING AND THE ASSESSMENT OF SEASONAL FLOOD RISK,
For primary bibliographic entry see Field 2B.
W83-04019

CHARACTERISTICS OF SEDIMENT AND ORGANIC CARBON EXPORT FROM PRISTINE BOREAL FOREST WATERSHEDS,
Woods Hole Oceanographic Institution, MA.
R. J. Naiman.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 12, p 1699-1718, December, 1982. 14 Fig, 6 Tab, 46 Ref.

Descriptors: *Organic matter, *Forest watersheds, *Sediment transport, Organic carbon, Rivers, Stream order, Particulate matter, Quebec, Suspended load.

Sediment and organic matter were measured in 1979-81 in five pristine Quebec streams: First Choice Creek (1st order), Beaver Creek (2nd order), Muskrat River (5th order), Matamek River (6th order), and Moisie River (9th order). During the 2-month spring freshet 71-92% of the annual sediment load and 59-65% of the annual particulate organic matter (POM) load are exported. Sediment yield varies from 1.5 to 7.6 g per sq m per year; POM export, from 1.0 to 6.7 g ash free dry weight per sq m per year; and dissolved organic carbon export, from 3.1 to 48.4 g C per sq m per year. Apparently carbon is rapidly loaded between first and second order streams, after which biological and physical processing increases. POM export/input ratios were 2.5 in the first order stream, 8.3 in the second order stream, and 0.3-0.6 in the higher order streams. In the largest watershed, Moisie River, the C export was 4.7 g C per sq m per year; coarse particulate organic matter, negligible; and oxidation of suspended load, <0.5% per day. Concentrations of organic matter are relatively unaffected by summer storms, diel variations, and depth of sample in the water column. However, in streams processing and retention devices do exert considerable control over the quantity and nature of suspended organic matter. (Cassar-FRC)
W83-04109

EVALUATION OF PEAK PREDICTION PRACTICES IN RELATION TO FLOODS, FLASH FLOODS, AND DAM SAFETY ACT,
Texas Univ. at El Paso. Dept. of Chemical Engineering.
H. S. Oey, and P. W. Young.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105360. Price codes: A08 in paper copy, A01 in microfiche. Water Resources Institute Completion Report, Texas A and M Univ., College Station, September 1983. 141 p, 4 Fig, 16 Tab, 45 Ref, 4 Append. OWRT B-247-TEX(1), 14-34-0001-1268.

Descriptors: *Prediction, Synthesis, *Flood peaks, Runoff peaks, Drainage, Spillway, *Stochastic methods, *Deterministic methods, River basins, Colorado River, Brazos River, *Texas, Data analysis, Data collections.

The primary goal was to evaluate the applicability of a variety of basic and practical methods for prediction an synthesis of flood peaks within the hydrologic regions of the State of Texas. Historic peak flood data for streams of 26 drainage basins, located in the west, east, gulf coast and central regions of Texas were obtained from reports and computer 'printouts' of the Water Resources Division of the U. S. Geological Survey, Austin, Texas. The primary river basins of the streams were the Colorado and Brazos rivers. Streams at all sites were unregulated, natural and had at least seven years of flow records. Drainage basins are predominately rural in population and small in area, i.e., less than 40 - square miles. Historic flood peak data for all the drainage basins were analyzed in the stochastic methods unit of this study. With the aid of statistical tests, the 'best-fitting' frequency distribution was identified and peak flow estimates associated with recurrence intervals of 2, 5, 10, 25, 50 and 100 years were made for all drainage basins. Flood peak estimates associated with the 5, 10, 25, 50, and 100 year recurrence intervals were made for each deterministic method for all the drainage basins. In order to evaluate the deterministic methods, a correlation, regression analysis of these methods to the results of stochastic analysis (observed data) was made for each drainage basin.
W83-04138

2F. Groundwater

DEVELOPMENT OF GROUNDWATER ON A RETREATING BARRIER BEACH IN RELATION TO OVERWASH AND DUNE FORMATION ON CAPE COD, MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Botany.
For primary bibliographic entry see Field 3B.
W83-03907

GROUNDWATER-SURFACE WATER INTERACTION AT TOPAZ LAKE, NEVADA,
Nevada Univ. System, Reno. Desert Research Inst.
D. R. Price, S. W. Wheatcraft, R. L. Jacobson, and L. P. Bruce.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256776, Price codes: A07 in paper copy, A01 in microfiche. Publication No. 41085, August 1983. 130 p, 24 Fig, 8 Tab, 42 Ref. 2 Append. OWRT B-111-NEV(1), 14-34-0001-9121.

Descriptors: *Lake stages, Lake shores, *Water level fluctuations, *Bank storage, Water chemistry, Seepage, Groundwater movement, *Surface-groundwater reactions, *Nevada, Topaz Lake, *Aquifer characteristics, Recharge, Groundwater recharge.

A hydrologic study was conducted to investigate groundwater-lakewater interactions around Topaz Lake, Nevada, where an alluvial aquifer is hydraulically connected with the off-stream storage reservoir. Basic objectives of the study were: 1) the estimation of aquifer characteristics; 2) the estimation of recharge to the aquifer from the surrounding mountains; 3) the determination of the flux between the aquifer and the lake; and 4) the potential for contamination of the lake or groundwater from the other. While the lake was increasing in storage, aquifer recharge was determined to be 62% from the mountains and 38% from the reservoir substantiating the potential for impact on the aquifer by the reservoir. Groundwater seepage to the reservoir represented only one percent of its total volume, thus, degradation of the reservoir by groundwater is small.
W83-03920

HYDROGEOLOGICAL AND HYDROGEOCHEMICAL STUDIES OF THE UNSATURATED FLOW IN A GRAVEL AQUIFER. PART I. PLANNING AND CONSTRUCTION OF AN ACCESSIBLE SHAFT ENABLING THE SAMPLING OF PERCOLATION WATER AND GASES (HYDROGEOLOGISCHE UND HYDROGEOCHEMISCHE UNTERSUCHUNGEN IN DER UNGESATTIGTEN ZONE EINES KIESGRUNDWASSERLEITERS. TEIL 1),
Technische Univ., Munich (Germany, F.R.). Lehrstuhl fuer Hydrogeologie and Hydrochemie.
B. Merkel, G. Nemeth, P. Udluft, and W. Grimmeisen.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 15, No 4, p 191-195, August, 1982. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Aquifer, *Gravel, *Seepage, *Soil gases, *Groundwater movement, Soil temperature, Percolation, Flow, Conductivity, Unsaturated flow, Data collection, Measuring instruments, Automation, Data processing.

Design and construction of an accessible research shaft are discussed. Construction of the shaft had to minimize disturbance to the aquifer which was being investigated. The shaft itself was fitted with ladders and with ladders and with seven platforms at increasing depths to facilitate measurement and maintenance. With this shaft it is possible to study the unsaturated flow from a 12 meter thick aquifer. The pressure head, soil gas composition, and soil temperature can be determined. Seepage water is sampled with suction devices, and pH and conductivity measurements are recorded continously. Automatic data processing ensures a reliable data bank with high resolution potential over a long period. (Titus-FRC)
W83-03940

HYDROGEOLOGIC AND GEOCHEMICAL STUDIES OF SELECTED NATURAL RADIOISOTOPES AND BARIUM IN GROUNDWATER IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 2K.
W83-03989

ISOTOPE HYDROLOGY OF A BASIN AND RANGE GEOTHERMAL SYSTEM,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 2K.
W83-04000

A FIELD STUDY OF SOLUTE DISPERSION IN A SHALLOW, UNCONFINED AQUIFER,
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
D. F. Leland, and D. Hillel.
Soil Science Society of America Journal, Vol 46, No 5, p 905-912, September/October, 1982. 10 Fig, 2 Tab, 10 Ref.

Descriptors: *Solute transport, *Unconfined aquifers, Drainage, Groundwater flow, Solutes, Diffusion, Advection, *Dispersion, Massachusetts.

A field experiment was conducted in a very shallow, unconfined aquifer on a hillslope site to determine the characteristics of variation of saturated hydraulic conductivity and longitudinal dispersivity and to examine scale effects on quantification of the longitudinal dispersivity. Chloride tracer was injected into the saturated zone, and its downslope movement was monitored by means of multilevel samplers. The results showed that the mean value of the saturated hydraulic conductivity derived from the tracer test measurements is in very close agreement with mean values of saturat-

ed hydraulic conductivity obtained from two sets of independent measurements, namely, tests on core samples and double-ring infilrometer tests. The experiment showed that tracer tests can be useful tools for studying the transport and dispersion of solutes in the field, though experimental design, including spatial layout and type of instrumentation, injection technique, and sampling frequency, must be carefully considered when developing such a study. (Baker-FRC)
W83-04030

FLOW PROCESSES IN THE FISSURE NETWORK MODEL (STROMUNGSVORGANGE IM VERMASCHTEN KLUFTMODELL),
Bundesanstalt fuer Gewaesserkunde, Coblenz (Germany, F.R.).
F. Schwille, and K. Ubell.
Gas- und Wasserfach: Wasser-Abwasser, Vol 123, No 12, p 585-593, 1982. 14 Fig, 1 Tab, 6 Ref.

Descriptors: *Geologic fractures, *Flow, Groundwater, Computers, Drawdown, Fissure water, Fault springs, Groundwater contamination, Hydraulics, Fluid mechanics.

The influence of fissure distribution and fissure aperture size on the flow processes in rock has been studied assuming an idealized, schematic form of fissure systems and based on the known laws of fissure flow. Forty cases with different fissure geometry have been solved based on the assumed parameters of fissures. The computer program has been developed from an existent program for meshed pipe networks. Using some selected examples, the most essential results are presented as patterns of potential and flow distribution. The comprehensive interpretation of the model results permits conclusions to be drawn for practical application in groundwater hydrology. The results obtained are of importance, for example, in evaluating the effects to be expected as a result of groundwater drawdown in the construction of deep rock excavations or of drawdown due to wells. Conclusions regarding the migration of contaminants and localization of contamiantion sources may also be drawn. (Baker-FRC)
W83-04092

ESTIMATION OF AQUIFER TRANSMISSIVITIES USING NUMERICAL MODELS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105550, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, September 1983. 13 p, 26 Ref. OWRT A-097-ARIZ(2), 14-34-0001-1103.

Descriptors: *Transmissivity, Hydrogeology, Model studies, Theoretical analysis, *Aquifer characteristics, *Arizona, Avra Valley aquifer, Groundwater movement.

Inverse modeling of aquifers usually involves identification of effective transmissivities over a finite number of subregions, or zones. Theoretical restrictions on the maximum size of a zone for which effective transmissivities can be properly defined and the desire to obtain a good resolution of the spatial variability of transmissivity may suggest that the aquifer be divided into numerous small zones. On the other hand, considerations of parameter identifiability may require that the number of unknown transmissivities be limited. An inverse approach has been developed in which the number of zones can be as large as deemed necessary on the basis of hydrogeological considerations. However, instead of trying to estimate a similar number of transmissivities, one estimates a smaller number of surrogate parameters which are linear combinations of the original log transmissivities. The number of surrogate parameters is determined through a singular value decomposition of a matrix arising from the linearization of the inverse problem. This singular value decomposition also yields a 'resolution matrix' and an 'information density matrix.' The resolution matrix is indicative of parameter identifiability and can be used to rezone the study area. The information density matrix shows how well the model can reproduce each measured hydraulic head value and can be used to determine the relative value of each datum point for parameter estimation. The methodology is illustrated on the Avra Valley aquifer of southern Arizona.
W83-04157

PREDICTING DEPTH TO THE WATER TABLE BASED ON SPECIES PRESENCE ON AN OREGON COAST DEFLATION PLAIN,
University of Western Ontario, London. Dept. of Plant Sciences.
K. W. Newman.
Canadian Journal of Botany, Vol 61, No 2, p 482-487, 1983. 6 Tab, 9 Ref.

Descriptors: *Water table, Prediction, Vegetation, *Groundwater level, *Water table profiles, Mathematical studies, Model studies, Groundwater, Areal hydrogeology, *Oregon.

A new method for predicting depth to the water table based on plant species present is described. The study area consisted of three transects at right angles to the shore across a deflation plain between Carter Lake and Tahkenitch Creek along the central Oregon coast. Depth to the water table and the presence or absence of 27 species were recorded for 332 quadrats. Quadrats were classified by age according to aerial photographs of vegetation and weighted according to the inverse of their inclusion probabilities. Prediction of water-table depth was based on the intersection of the ranges or 'percentiles of ranges' of the species in a quadrat. Results showed that for 96% of the quadrats, water-table depth was predicted to within 10 cm and for 73% of the quadrats, to within 5 cm. The present method can also be applied to other studies for predicting the value of environmental variables based on species presence. (Geiger-FRC)
W83-04193

2G. Water In Soils

STUDIES ON SOIL MOISTURE STORAGE UNDER CONTOUR FURROW DURING THE GROWING SEASON OF CENCHRUS CILIARIS,
Central Arid Zone Research Inst., Jodhpur (India).
K. D. Sharma, C. M. Verma, and A. K. Kalla.
Annals of Arid Zone, Vol 19 No 1/2, p 37-42, March-June, 1980. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Soil moisture retention, *Furrows, Grasses, Germination, Moisture profiles, Soil-water plant relationships, *India, Jodhpur.

Soil moisture conditions were best for germination and growth of Cenchrus ciliaris, a grass, at the center of the furrow. Soil moisture dynamics were weekly at the center of the furrow, middle of the ridge, top of the mound, and center line of horizontal spacing from June to September, 1977 and 1978,in sandy loams at Jodhpur, India. Plant populations per ha for different seeding treatmens were: top of mound, 14757; middle of ridge, 15798; and broadcast on entire mound, 12837. Dry forage yields followed a similar pattern. Moisture retention at the middle of the ridge was similar to that in the center of the furrow. (Cassar-FRC)
W83-03883

MEASUREMENT OF WATER FLOWS IN UNSATURATED MEDIA,
A. I. Budagovskii, and E. M. Gusev.
Water Resources (English Translation), Vol 9, No 2, p 135-144, March/April, 1982. 3 Fig, 2 Tab, 10 Ref. Translated from Vodnye Resursy, No 2, p 36-45, March/April, 1982.

Descriptors: *Unsaturated flow, *Data acquisition, Water management, Water supply, Mathematical equations, Water transport, Groundwater flow.

Control of soil waters plays a substantial role in the solution of water resource problems. Results of measuring water flows in unsaturated media and parameters are needed for substantiating and constructing semiempirical and empirical relations with respect to particular cases of transport, with their subsequent use as a palliative in more general models of the formation of soil waters. The selection of the method to be used for determining the potential of soil water is related mainly to the range of its variations for which the flows are determined. In the case of high moisture contents, when the absolute value of the potential is less than 0.8 bar, it is best to use tensiometers. For coarse-textured soils it is advisable also to use the method of tali columns. It is stressed that the dependence of the coefficient of hydraulic conductivity on soil moisture is essentially ambiguous. This fact indicates the incorrectness of transient method of determining the coefficient of hydraulic conductivity based on the use of the Buckingham-Darcy equation. However, the experience of using the moisture dependencs of hydraulic conductivity obtained by such methods shows that in certain cases they can be used as relatively effective approximation dependence in mathematical modeling of transport processes. (Baker-FRC)
W83-03948

PREDICTION OF RAINFALL EXCESS AND SOIL WATER FLUX FROM VARIABLE STORMS ON LAYERED FIELD SOILS,
New South Wales Univ., Kensington (Australia).
For primary bibliographic entry see Field 2A.
W83-03962

A PROBABILISTIC MODEL FOR ASSESSMENT OF PLANT WATER AVAILABILITY,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
K. B. Rojiani, B. B. Ross, F. E. Woeste, and V. O. Shanholtz.
Transactions of the ASAE, Vol 25, No 5, p 1576-1580, 1588, November/December, 1982. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Plant water potential, *Soil-water-plant relationships, *Probabilistic process, Mathematical studies, Soil water, Projections, Mathematical models, Agriculture, Irrigation.

A probabilistic model has been developed for assessing available soil water. The model predicts upper and lower bounds on the probability of occurrence of soil moisture deficits over a given period starting at any point during the growing season. Data on the amount of plant available water on each day of the growing season generated from soil moisture balance model for a period of 50 years are used as input for the model. Since plant available water is a function of root development and soil water transmission characteristics, the maximum water holding capacity is used as a parameter for the model. As a result, it is possible to predict the probability of occurrence of soil moisture deficits for a range of soil types and plant types. It is also possible to use the model to determine which input parameters have a significant impact on the computed probabilities so that available resources can best be used to obtain better estimates of those parametes. The correlation between the amount of plant available water on successive days is considered in the formulation. Results indicate that the computed probability bounds are extremely close, usually less than 10%, and can be quite useful in the decision making process. The model provides valuable information for the long-term planning of agricultural activities and for assessing the feasibility of providing water by irrigation. (Carroll-FRC)
W83-03972

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF UNSATURATED SOILS WITH THERMOCOUPLE PSYCHROMETERS,
Texas Univ. at Austin. Geotechnical Engineering Center.
D. E. Daniel.
Soil Science Society of America Journal, Vol 46, No 6, p 1125-1129, November/December, 1982. 6 Fig, 1 Tab, 19 Ref.

Descriptors: *Permeability coefficient, *Measuring instruments, Unsaturated soils, Psychrometers,

Clays, Soil properties, Texas, New Mexico, Mississippi.

A method of measuring the hydraulic conductivity of unsaturated soil using the instantaneous profile method with psychrometric probes to measure water potential is developed and described. Soil is compacted into cylindrical tubes, and the tubes are sealed and instrumented with thermocouple psychrometers. The soil is moistened or dried from one end of the tube. Psychrometers are read periodically. Hydraulic conductivity is computed from the psychrometer readings and the appropriate moisture characteristic curve for the soil and then plotted as a function of water potential, water content or degree of saturation. Hydraulic conductivities of six soils were measured at water potentials as low as -80 bars. The measured hydraulic conductivities and moisture characteristic curves were used along with known boundary flux in a computer program to calculate the final water content profiles. Computer and measured final water content profiles agreed tolerably well. Since psychrometers can be used in the field, this method shows promise for in-situ applications. (Baker-FRC)
W83-04025

WATER INFILTRATION AND REDISTRIBUTING IN A SILT LOAM SUBSOIL WITH VERTICAL WORM CHANNELS,
Stichting voor Bodemkartering, Wageningen (Netherlands).
J. Bouma, C. F. M. Belmans, and L. W. Dekker.
Soil Science Society of America Journal, Vol 46, No 5, p 917-921, September/October, 1982. 5 Fig, 18 Ref.

Descriptors: *Soil water, *Infiltration, Channels, Mathematical equations, Silt, *Loam, Soil types, *Macropores, Vertical worm channels, Soil saturation.

The infiltration of water into soil containing macropores which are temporarily being filled with water was investigated. The macropores were dominantly vertical worm channels. Three different types of steady infiltration rates were measured in individual worm channels. The rates were associated with the following conditions: (1) low steady rates of 20 cu cm/min were measured in channels in which the earthworm was still present within 50 cm below the surface of infiltration; (2) higher rates of 140 cu cm/min were measured in long, more or less vertical channels which extended to a maximum depth of 1.6 m below surface; and (3) high rates of 400 cu cm/min were measured in channels which ended within 50 cm below the surface of infiltration, in highly porous mole burrows. The measured, dominant infiltration rate in a channel was used to calculate ponding time on and the associated water movement in the soil matrix after adding 2 cm of water. The latter was calculated with an existing simulation model for one dimensional infiltration in homogeneous soil. Calculations of the pressure head indicated lack of soil saturation. This agreed only with in-situ measurements when small tensiometer cups were used. Large cups intercepted water-conducting macropores, erroneously suggesting saturation of the entire soil matrix. Addition of a 5 cm thick layer of sand to the surface of infiltration made the macropores discontinuous and induced saturated conditions, as measured and simulated. Measurement of infiltration rates into individual macropores, rather than calculation of those rates, is recommended when macropore morphology is irregular. (Baker-FRC)
W83-04026

INTERNAL ENERGY BALANCE AND THE RICHARDS EQUATION,
G. Sposito, and S. -Y. Chu.
Soil Science Society of America Journal, Vol 46, No 5, p 889-893, September/October, 1982. 23 Ref.

Descriptors: *Soil water, *Flow characteristics, Mathematical equations, *Richards Equation, *Unsaturated flow, Flow, *Energy balance.

The fundamental Richards Equation is deduced as a special case of the differential law of internal energy balance for water in an unsaturated soil. No direct appeal is made to the law of mass balance. Thus it is differential balance law and a linear flux law entirely within the energy concept of soil water. The accepted physical equivalence of the two alternate forms of the Richards Equation thereby has been established in a more precise manner. The equation is shown to comprise both heat flux and chemical work terms, in correspondence with the first law of thermodynamics. For the case of isothermal water flow through a rigid, homogeneous soil, the balance law for internal energy reduces to the Richards Equation, with the soil water matric potential as the dependent variable. The result demonstrates that the energy concept of soil water provides a self-consistent method for obtaining the Richards Equation. Either the energy balance concept or the traditional mass-balance approach can be used to establish the macroscopic physical foundations of the Richards equation. (Baker-FRC)
W83-04027

SEASONAL VARIATION IN NUTRIENTS OF FLOODPLAIN AND UPLAND FOREST SOILS OF CENTRAL ILLINOIS,
Pacific Southwest Forest and Range Experiment Station, Riverside, CA.
D. L. Peterson, and G. L. Rolfe.
Soil Science Society of America Journal, Vol 46, No 6, p 1310-1315, November/December, 1982. 4 Fig, 1 Tab, 32 Ref.

Descriptors: *Nutrients, *Seasonal variations, *Soil types, Calcium, Magnesium, Potassium, Sodium, Phosphorus, Nutrient cycling, Acidity, Soil properties, Spatial distribution, Temporal distribution, *Illinois.

Soil chemical parameters of adjacent floodplain and upland forests in central Illinois were examined by using intensive replication during a two-year period of sampling. Correlation analysis and information from previous studies were used to identify factors related to this variation. Nutrient pools of all elements except sodium were greater in floodplain soils than in upland soils and were in the following order at both study sites: exchangeable calcium > exchangeable potassium > available phosphorus. Seasonal variation in nutrient content of soils was the result of several environmental factors. Available P in floodplain soils was highly dependent on pH, which was in turn influenced by flooding. There was no evidence of seasonal variation in available P for upland soils. Soil pH was positively correlated with the concentration of exchangeable bases in both soils, especially Ca and Mg in upland sites and may have been influenced by leaching and variation in tree root exudation. The seasonal variation in nutrient pools of forest soils in this study has implications for tree growth, site evaluation, and nutrient cycling in forest stands. (Baker-FRC)
W83-04029

ESTIMATING SATURATED HYDRAULIC CCONDUCTIVITY FROM SOIL MORPHOLOGY,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
J. A. McKeague, C. Wang, and G. C. Topp.
Soil Science Society of America Journal, Vol 46, No 6, p 1239-1244, November/December, 1982. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Permeability coefficient, *Soil properties, *Soil morphology, Mathematical/Equations, Soil water, Ontario, Quebec, New York.

Work was undertaken to develop guidelines for estimating the saturated hydraulic conductivity classes from observations of soil morphology. The guidelines presented, though incomplete and subjective to a degree, improved the estimates of saturated hydraulic conductivity in limited testing by pedologists who were not involved in the study. These guidelines show promise for contributing to improved estimates. The results indicate that it is not feasible to assign a unique K(sat) estimate to near-surface horizons of cultivated soils of a particular series. Tillage practices and current land use have a major effect on soil structure, porosity and density, and hence on K(sat). The K(sat) of the surface horizon is important relative to infiltration and runoff; K(sat) of a B horizon may result in a perched water table; K(sat) of horizons at a depth of about 1 m is related to spacing of tile drains. The eight K(sat) classes designated seem to be appropriate in number, but the class limits should be reassessed when more information is available on the variability of K(sat). (Baker-FRC)
W83-04031

DEFICIT, HIGH-FREQUENCY SPRINKLER IRRIGATION OF WHEAT,
Washington State Univ., Pullman. Coll. of Agriculture Research Center.
For primary bibliographic entry see Field 3F.
W83-04032

CHEMICAL AND MORPHOLOGICAL SOIL CHARACTERISTICS IN A NEW ENGLAND DRAINAGE-TOPOSEQUENCE,
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
P. L. M. Veneman, and S. M. Bodine.
Soil Science Society of America Journal, Vol 46, No 2, p 359-363, March/April, 1982. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Drainage, *Soil characteristics, Soil properties, Infiltration, Soil water, New England, Chemical properties, Morphological properties, *Massachusetts.

The chemical and physical properties of soils are studied in a representative Massachusetts catena. The occurrence of specific mottling patterns was noted in relation to soil moisture regimes, and the effectiveness of the present soil taxonomic criteria in separating true Spodosols from podzol-like soils was considered. The soils in this Paxton catena strongly reflected the glacial origin of the parent material. Most soils are underlain within 70 cm by a hardpan which is a dense basal till. The presence of the hardpan severely limits vertical drainage of excess soil moisture. During periods of saturation this water is forced to move laterally down slope because of the low permeability of the hardpan. This laterally moving water causes the soils at lower elevations to be wetter, resulting in the formation of significant mottling in the subsoil of profiles about one-third downslope. The mottling patterns in the B horizons of these moderately well drained soils show some ped and channel ferrans and albans, while irregular sesquioxidic nodules with chromas greater than that of the matrix color can be noted in weakly expressed ped interiors. Soil matrix colors in the somewhat poorly and poorly drained profiles were either 2.5Y or 5Y and characteristically had low chromas. Channel neoferrans were abundant in the Ridgebury soil but less plentiful in the Scarboro soils. Imperfect internal drainage of the hardpan throughout the catena was indicated by low chroma ped interiors and high chroma ferrans on ped surfaces. This mottling pattern reflects very wet but yet unsaturated soil conditions for a significant period of the year. (Baker-FRC)
W83-04036

INTERFLOW OF WATER THROUGH A SLOPING SOIL WITH SEEPAGE FACE,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
L. R. Ahuja, and J. D. Ross.
Soil Science Society of America Journal, Vol 46, No 2, p 245-250, March/April, 1982. 10 Fig, 16 Ref.

Descriptors: *Soil water, *Infiltration, *Drainage, Subsurface drainage, Flow, Lateral flow, Subsurface flow, Permeability, Water pollution effects, Water pollution sources, Fate of pollutants.

A theoretical analysis of saturated steady interflow in a sloping soil typical of a valley basin has been extended to analysis of sloping soil with seepage face, such as in the case of lateral flow to a ditch or a stream. Particular attention was given to the

interflow pathways, rates and source areas in a sloping soil on a field scale. The method of Gram-Schmidt orthonormalization was adopted. For a homogeneous soil resting on a sloping impermeable base the effects of slope length to soil depth ratio, soil slope, slope of the seepage face with respect to the base, and boundary conditions at the upper end of the slope were examined. Flow patterns were also examined for cases in which the base was somewhat permeable and/or when water standing in the ditch was covering part or all of the seepage face. The findings provide a step towards a better understanding and simplified description of the pathways, rates and contributing source areas of interflow in a sloping soil underlain by a horizon of very low permeability. The results are relevant especially for subsurface flow of soil chemicals to field runoff. They can also be used as guides to devise amelioration measures where a problem exists. (Baker-FRC)
W83-04040

INFILTRATION PREDICTION BASED ON ESTIMATION OF GREEN-AMPT WETTING FRONT PRESSURE HEAD FROM MEASUREMENTS OF SOIL WATER REDISTRIBUTION,
Southern Illinois Univ. at Carbondale. Dept. of Forestry.
S. K. Chong, R. E. Green, and L. R. Ahuja.
Soil Science Society of America Journal, Vol 46, No 2, p 235-239, March/April, 1982. 2 Fig, 2 Tab, 19 Ref.

Descriptors: *Soil moisture, *Infiltration, *Prediction, Mathematical equations, Permeability, Soil types, Green-Ampt equation, Pressure head, Wetting front, *Hawaii, Oahu.

A simple algebraic equation was derived for calculating the matric pressure head at the wetting front based on in situ soil water redistribution measurements. The pressure head, Hf, is given as a function of antecedent water content. The values of Hf thus obtained were used in the Green-Ampt equation to predict infiltration. The prediction error was small for initially dry soil, suggesting that this method has merit for soils with low antecedent water contents. The Green-Ampt equation was tested for topsoils whose depths ranged between 30 to 40 cm. For the dry antecedent conditions, the different soils required between 2 and 13 cm of infiltration water to be satiated to this depth. Thus the topsoils (Ap horizon) would be the controlling horizon for infiltration of rainfall, especially in areas where rainstorms are short and intense. Nevertheless for long-duration rainfall the application of the Green-Ampt equation must be expanded to subsoil B horizons of generally smaller hydraulic conductivity and porosity and a different soil moisture condition. (Baker-FRC)
W83-04041

WETTING MOISTURE CHARACTERISTIC CURVES DERIVED FROM CONSTANT-RATE INFILTRATION INTO THIN SOIL SAMPLES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
K. M. Perroux, P. A. C. Raats, and D. E. Smiles.
Soil Science Society of America Journal, Vol 46, No 2, p 231-234, March-April, 1982. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Soil water, *Soil properties, Measuring instruments, Darcy's Law, Tensiometer, Water transport, Solute transport, Infiltration, Permeability, Loam, Sand, Clay, Pressure head.

A rapid and precise method for obtaining a wetting curve by supplying a small constant flux of water to the top of a thin section of soil fully occupying a cell of known volume and measuring the pressure head at the bottom with a pressure transducer is described. The method depends on the notion that the increase in moisture content of the soil can be inferred from the influx, provided no water is lost from the sample. If the sample is thin and the rate of application of water is low enough the pressure head difference across the sample will tend toward zero. This condition implies that the measured pressure head and a mean water content are applicable to the whole sample. The technique is demonstrated using a fine sand, a loam, and a silty clay loam, and comparison is made with data obtained from other methods. (Baker-FRC)
W83-04042

LONG-TERM EFFECTS OF MANURE ON SOIL NITROGEN, PHOSPHORUS, POTASSIUM, SODIUM, ORGANIC MATTER, AND WATER INFILTRATION RATE,
Agricultural Research Service, Shafter, CA. Cotton Research Station.
B. Meek, L. Graham, and T. Donovan.
Soil Science Society of America Journal, Vol 46, No 5, p 1014-1019, September/October, 1982. 2 Fig, 6 Tab, 14 Ref.

Descriptors: *Water infiltration, *Minerals, *Land disposal, Sewage disposal, Manure, Land application, Nitrogen, Phosphorus, Nutrients, Sodium, Bicarbonates, Denitrification, Soil water, Permeability, Mineralization, *California.

Changes in soil physical and chemical properties were measured during a 9 year period in plots receiving various rates of manure application. High rates of manure were added to field plots of Holtville silty clay soil in an irrigated desert region. Manure applications resulted in large losses of N, increased levels of K, increased P availability, increased water intake rates during the growing season, and an N mineralization rate of about 5% after the first year. At high rates of application only 42% of the N applied could be accounted for. One application of 180 t/ha of manure in 1971 doubled the sodium bicarbonate extractable P levels in the soil in 1979 compared with that of plots that did not receive manure. The application of manure had only a small or no effect on the water intake rate when it was measured between cropping periods on plots that had been recently tilled, but differences were large when water intake rates were measured while the crop was growing. The increased water infiltration rates during the growing season would be important because of increased crop yields in areas affected by salinity. (Baker-FRC)
W83-04043

DETERMINATION OF SORPTIVITY BASED ON IN-SITU SOIL WATER REDISTRIBUTION MEASUREMENTS,
Southern Illinois Univ. at Carbondale. Dept. of Forestry.
S. K. Chong, R. E. Green, and L. R. Ahuja.
Soil Science Society of America Journal, Vol 46, No 2, p 228-230, March/April, 1982. 2 Fig, 1 Tab, 19 Ref.

Descriptors: *Soil water, *Sorption, Infiltration, Permeability, *Oxisols, Mathematical equations, Data acquistion, *Hawaii, Oahu.

A simple, physically based algebraic equation is derived for calculating sorptivity as a function of antecedent soil water content. The wetting fron matric pressure head determined from the field profile redistribution data in a previous study is utilizedin an equation which gives sorptivity as a function of fillable porosity, that is, the difference between the satiated and antecedent soil water content, satiated hydraulic conductivity, and wetting fron matric pressurē head. The final equation gives sorptivity explicitly as a function of antecedent water content, with the soil water content and satiated hydraulic conductivity being constants for a given soil. The calculated sorptivity is assessed by its use in the Talsma-Parlange infiltration equation and subsequent comparison of predicted and measured infiltration. The method was tested on seven different sites with 14 infiltration measurements on Oxisol soils of Hawaii. The percentage error between predicted and measured cumulative infiltration ranged from 2.1% to 51.9%, with an average error of 21.8% for the 14 comparisons. (Baker-FRC)
W83-04044

SPATIAL VARIABILITY OF SOIL HYDRAULICS AND REMOTELY SENSED SOIL PARAMETERS,
Texas Agricultural Experiment Station, College Station.
R. J. Lascano, and C. H. M. Van Bavel.
Soil Science Society of America Journal, Vol 46, No 2, p 223-228, March/April, 1982. 9 Fig, 18 Ref.

Descriptors: *Remote sensing, *Spatial distribution, *Soil water, Hydraulics, Soil properties, Simulation, Temperature effects, Scaling, Surface temperature, Model studies.

Remote sensing technology using microwave or thermal radiation detection from spacecraft tends to have a resolution of 25 to 2,500 ha, far in excess of the scale of soil variability. In this study such problems are addressed specifically in regard to the effect of soil variability on surface soil water content, water potential, and temperature. This analysis is based on a characterization of spatial variability by the concept of similar media and by the value of a universal scaling parameter that applies to water content-water potential and water content-water conductivity relationships. This scaling concept is then combined with the appropriate distribution function and with a finite difference model of the simultaneous flow of water and heat in a soil profile that is bare. Daily losses by evaporation from the 1.5 m uniform profile at the upper boundary and by drainage at the lower boundary are graphed. Only during the precipitous decline of evaporation from a wet to a dry surface can one expect a significant absolute difference corresponding to the spread of the scale factor. Of direct interest to remote sensing applications is the water content in the top 0.20 m of the soil, the latter being the approximate depth of perception by passive microwave detection, depending on the frequency used. During a rainless period the variation of soil properties does not induce a significant variation of the water content in the surface, with 90% of the expected values in a bandwidth of about 1 mm, or 2 to 5% of the total value. Immediately after a 50-mm rainfall, the variability is greater, about 8 mm, or 10 to 15% of the total value. Variability in surface temperature is also important. (Baker-FRC)
W83-04062

FIELD TESTING OF A TWO-DIMENSIONAL SOIL MOISTURE MODEL SIMULATING WATER TABLE FLUCTUATIONS,
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
M. J. Fayer, and D. Hillel.
Soil Science Society of America Journal, Vol 46, No 2, p 396-404, March/April, 1982. 16 Fig, 15 Ref.

Descriptors: *Soil moisture availability, *Model studies, *Water table fluctuations, Water level fluctuations, Groundwater movement, Soil water, *Simulation, *Massachusetts.

The validity of a two-dimensional model of soil-water dynamics in a sloping field was tested with respect to groundwater level fluctuations during several infiltration-drainage cycles. The data from rain recorders, runoff plots, water table wells, tensiometers, and an evaporation pan were used to describe the various initial and boundary conditions. Soil hydraulic properties were determined from undisturbed cores and in situ methods. Comparisons of the predicted and measured water table positions were used to judge the model's capabilities. After two 1-wk periods of no rainfall, during which the actual water table fell 11 and 79 cm, the predicted water table levels were within 1.5 and 8 cm, respectively, of the measured levels. Before and immediately after periods of rainfall, the predicted water table levels were usually within 2 cm of the measured levels. As the water table rose in response to the rainstorm, however, the predicted rise was only one-half that measured in the field. Altering the shape of the moisture characteristic programmed in the model nearly doubled the predicted rise. Hence the discrepancy between prediction and observation may be due to insufficient accuracy in determination of the soil moisture characteristic in the very wet range, or to failure to

account for air occlusion or hysteresis. (Baker-FRC)
W83-04063

FLOW OF KAOLINITE AND SEWAGE SUSPENSIONS IN SAND AND SAND-SILT: I. ACCUMULATION OF SUSPENSION PARTICLES,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W83-04068

FLOW OF KAOLINITE AND SEWAGE SUSPENSIONS IN SAND AND SAND-SILT: II. HYDRAULIC CONDUCTIVITY REDUCTION,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W83-04069

HYDRAULIC CONDUCTIVITY OF SOIL AS DETERMINED FROM CUMULATIVE RUNOFF,
North Dakota State Univ., Mandan. Land Reclamation Research Center.
S. A. Schroeder, G. R. Foster, W. C. Moldenhauer, and J. V. Mannering.
Soil Science Society of America Journal, Vol 46, No 6, p 1267-1270, November/December, 1982. 5 Tab, 12 Ref.

Descriptors: *Permeability coefficient, Mathematical equations, *Runoff, Rainfall-runoff relationships, Infiltration, Green-Ampt, Simulation, Model studies, Soil permeability, Soil properties, *Hydraulic conductivity.

Hydraulic conductivity measurements using a Purdue sprinkling infiltrometer were performed on plots with the resultant data of cumulative runoff vs. time analyzed to determine values of hydraulic conductivity through the use of a cumulative runoff equation based on an infiltration equation proposed by Swartzendruber. No large differences were found between the cumulative runoff method, the infiltration equation it is based on, and an equation from Swartzendruber and Youngs that is similar in form to Philip's infiltration equation for estimating K. Estimated K was generally insensitive to the length of record from 30 to 60 min in these studies. Exponent values for infiltration rate equations could not be accurately determined for the particular soils in this study due to the small difference between the application rate and final infiltration rate. Within the range of data points used, values of hydraulic conductivity K were not sensitive to grouping of data points vs. using every data point available. Random error had little effect on K. Thus the procedure as outlined using Swartzendruber's second proposed infiltration equation and the linear equation derived using Sulaiman's methodology was judged to be as reliable in calculating hydraulic conductivity from cumulative runoff vs. time as several infiltration rate equations. This research establishes the procedure which might be used by other researchers to evaluate hydraulic conductivity of soils under a variety of conditions. (Baker-FRC)
W83-04071

2H. Lakes

LONG-TIME EVOLUTION OF AN UNSTABLE WATER-WAVE TRAIN,
Coastal and Marine Engineering Research Inst., Haifa (Israel). Dept. of Civil Engineering.
M. Stiassnie, and U. I. Kroszynski.
Journal of Fluid Mechanics, Vol 116, p 207-225, 1982. 10 Fig, 1 Tab, 16 Ref.

Descriptors: *Wave trains, *Water surface profiles, *Mathematical equations, Water level, Waves, Jacobian functions, Scrodinger equations.

The long-time evolution of an unstable wave train, consisting of a carrier wave and two 'side-band' components, is investigated analytically. Mathematical expressions involving Jacobian elliptic functions for the wave envelope characteristics are derived. The solution yields the dependence of the long-term evolution on the initial disturbance. Of special interest is the simple formula for the modulation-demodulation recurrence period. The latter is shown to yield results in good agreement with those obtained from numerical solutions of the nonlinear Schrodinger equation. While it is suggested that a system allowing for more interacting components must be considered, it is felt that the approximate analytical solution yields a reliable qualitative indication of the general trends and behavior of the recurrence phenomenon, especially during the onset of the process, where little energy has dispersed out of or entered the simplified system. The analytical solution will be helpful in visualizing the evolution of the water surface level in space and time and in deriving the relevant characteristic scales. Also, it leads to approximate expressions for the mean free-surface variation and mean current. (Baker-FRC)
W83-03855

PRODUCTIVITY MEASUREMENT AND THE STORAGE OF OXYGEN IN THE AERENCHYMA OF AQUATIC MACROPHYTES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
M. G. Kelly, B. Moeslund, and N. Thyssen.
Archiv fur Hydrobiologies, Vol 92, No 1, p 1-10, August, 1981. 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Macrophytes, *Aquatic productivity, *Respiration, *Oxygen transfer, Oxygen uptake, Dynamics, Aquatic plants, Plant tissues, Photosynthesis, Oxygen balance, Model studies, Rivers, Vascular tissues.

For the common and typical river species of aquatic macrophytes, it appears that oxygen storage in their aerenchyma tissues does not significantly affect oxygen release to the surrounding water. Storage of oxygen was negligible, so it did not seem to be important for productivity measurements or modeling oxygen dynamics. This suggests that oxygen measurements should prove as reliable for estimating productivity of most vascular macrophytes as they are in calculating the productivity of periphytic algae. Also, when modeling the effects of macrophyte respiration and photosynthesis in rivers, the storage of gases in aerenchyma need not be taken into account. More research is needed to determine the importance of oxygen transport to roots and rhizomes; however, it should be included with other communityrepiration processes when the simple mass balance equation is used for modeling oxygen dynamics or estimating productivity in rivers. (Geiger-FRC)
W83-03890

SEASONAL VARIATION IN THE MACROINVERTEBRATE FAUNA OF BILLABONGS ALONG MAGELA CREEK, NORTHERN TERRITORY,
National Museum of Victoria, Melbourne (Australia).
R. Marchant.
Australian Journal of Marine and Freshwater Research, Vol 33, No 2, p 329-342, 1982. 2 Fig, 2 Tab, 21 Ref.

Descriptors: *Invertebrates, *Seasonal variation, *Species composition, Streams, Billabongs, Magela Creek, *Australia, Macroinvertebrates, Baseline studies, Macrophytes, Aquatic plants, Species diversity, Aquatic animals, Littoral zone.

The littoral zones of 5 permanent billabongs (pools in or near a creek bed) along Magela Creek, Australia, were sampled for invertebrates monthly from March 1979 to March 1980 as part of a baseline study. The creek flowed only during December to April. In the 3 shallow (2-3 m) billabongs the greatest number of taxa (45) and individuals (1000 per min) were caught in the late wet season and early dry season (April-July). The minimum (18 taxa and 200 individuals per min) was reached at the end of the dry season in December. In the deep channel billabongs (7-10 m) fluctuations were not as marked, about 20-40 taxa and 400-850 individuals per min. Mean compsotion of fauna was similar in all billabongs. Oligochaetes and Hydracarina were the most common groups. Tricladida was less abundant. Taxa which occurred sporadically were Porifera, Hydridae, Gordiidae, and Hirudinea. The growth of macrophytes in the wet season is believed responsible for the seasonal variations. (Cassar-FRC)
W83-03891

ON RELATIONSHIPS BETWEEN STOCHASTICAL CHARACTERISTICS OF AN AQUATIC ECOSYSTEM AND ITS ENTROPY PRODUCTION,
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
P. Braun, and A. H. Gnauck.
Acta Hydrochimica et Hydrobiologica, Vol 9, No 2, p 213-217, 1981. 14 Ref.

Descriptors: *Model studies, *Stochastic processes, *Entropy, *Thermodynamics, Aquatic environment, Probabilistic processes, Mathematical studies, Ecosystems, Ecology, *Markov process, Mathematical equations, Lakes.

An attempt is made to calculate the excess entropy production of an aquatic ecosystem using a stochastic model. An equation is derived demonstrating the relationship between probabilistic and thermodynamic quantities which assumes equivalence of the statistical entropy definition by Boltzmann and the information entropy defined by Shannon . Other equations are presented which provide a Markov process and determine the probabilistic properties of the Markov process. It is possible to calculate thermodynamic and information qualities alternatively by checking the probabilistic behavior of a stochastical dynamic system. An extremal principle which permits an assessment of the further evolution of an aquatic system can also be derived. (Small-FRC)
W83-04045

SEASONAL FLUCTUATIONS IN RIVER BACTERIA AS MEASURED BY MULTIVARIATE STATISTICAL ANALYSIS OF CONTINUOUS CULTURES,
Windsor Univ. (Ontario). Environmental Microbiology Research Lab.
C. R. Bell, M. A. Holder-Franklin, and M. Franklin.
Canadian Journal of Microbiology, Vol 28, No 8, p 959-975, August, 1982. 7 Fig, 6 Tab, 48 Ref.

Descriptors: *Bacteria, *Seasonal variation, *Species diversity, Heterotrophic bacteria, Rivers, Meduxnekeag River, Dunbar River, *New Brunswick, Cultures, Nutrients, Nitrogen, Species composition, Temperature effects, Multivariate analysis, Statistical analysis, Organic matter, Dissolved oxygen, Oxygen.

Continuous culture enrichments of bacteria in two rivers, the Meduxnekeag and Dunbar, New Brunswick, were done using summer and winter samples. The river and/or season influenced species composition and diversity, physiological factors, and nutritional versatility. Diversity of Meduxnekeag bacteria, acclimated to organic matter, increased upon incubation. Diversity of bacteria from Dunbar, a river with high dissolved oxygen levels, decreased. Cell output from the cultures was affected by temperature and nitrogen, with nitrogen as the limiting nutrient. Cell output was not influenced by rivers or season. Species diversity was lower at 5C than at 20C. High N concentrations lowered species diversity. Populations in the river and populations incubated in the chemostat were different, although they were the same at the start of incubation. (Cassar-FRC)
W83-04059

ZOOPLANKTON DIVERSITY AND BIOMASS IN RECENTLY ACIDIFIED LAKES,
Ithaca Coll., NY. Dept. of Biology.
J. L. Confer, and T. Kaaret.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 40, No 1, p 36-42, 1983. 2 Fig, 2 Tab, 24 Ref.

Descriptors: *Acidic water, *Zooplankton, *Population dynamics, Biomass, Lakes, Adirondack

Mountains, White Mountains Mountain Lakes, Cladocera.

A survey was conducted to determine if effects on zooplankton similar to these found in other regions of the world have occurred in acidified lakes in mountainous regions of the northeastern United States. Samples were taken of zooplankton from 10 lakes in both the White Mountains of New Hampshire and the Adirondack Mountains of New York during July and August of 1979. The findings suggest that recent acidification, or some close correlate of acidification has had a strong effect on both zooplankton diversity and zooplankton biomass. The effects were observed to be a continuous function of pH over a wide spectrum of pH values. A loss of 2.4 species of zooplankton and 22.6 mg dry wt/sq m was correlated with each unit decrease in pH. A continuous decrease in diversity and biomass was noted over the entire pH range of 4.5 to 7.2. Cladocera, with the exception of Holopedium, Polyphemus and Epischura lacustris, Mesocyclops edax, and Cyclops scutifr, were abundant at higher pH values but rare or absent at pH values less than 5. Diaptomus minutus was predominant at pH values less than 5. (Baker-FRC)
W83-04103

TOTAL DISSOLVED SOLIDS AS A PREDICTOR OF LAKE BIOMASS AND PRODUCTIVITY,
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W83-04106

EVALUATION OF THE PHOSPHORUS-CHLOROPHYLL RELATIONSHIP FOR LAKES OFF THE PRECAMBRIAN SHIELD IN WESTERN CANADA,
Alberta Univ., Edmonton. Dept. of Zoology.
E. E. Prepas, and D. O. Trew.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 40, No 1, p 27-35, 1983. 4 Fig, 3 Tab, 28 Ref.

Descriptors: *Lakes, *Phosphorus, *Chlorophyll, Saline lakes, Meromictic lakes, Alberta, Canada, Precambrian Shield, Nitrogen, Nutrients, Eutrophication.

Data were collected on summer chlorophyll (ch1), spring and summer total phosphorus (TP), and total nitrogen (TN) for 25 lakes in Alberta to determine the nature of the relationship between TP and/or TN and Ch1 a. The TP-Ch1 relationship established in this study was also compared to that reported in other studies. The TP-Ch1 relationship found in this study was similar to those reported for lakes on the Precambrian Shield. Also the TN:TP ratios were similar. The mean TN:TP ratio in spring was 34, and in the trophogenic zone in summer it was 37. Both the Ch1:TP and the TN:TP ratios were much higher than those reported by others for lakes in the same area or indeed for other studies on the same lakes. It is suggested that some of these differences arose from the use of different analytical methods in the data gathering segment of the studies. The close correlation between levels of TP and Ch1 a and the high TN:TP ratios found in this study suggest that phosphorus is the nutrient controlling the level of phytoplankton productivity in western Canadian lakes. It is also suggested that dividing the lakes into three categories (shallow productive, thermally stratified, and saline) would improve the correlation between spring TP and summer Ch1. However, the seasonal fluctuations of TP in the shallow productive lakes and the drop in TP levels during the summer in the thermally stratified lakes need further study. (Baker-FRC)
W83-04107

LIMNOLOGY OF LAHONTAN RESERVOIR, 1980-1982,
Nevada Univ. System, Reno. Bioresources Center.
For primary bibliographic entry see Field 5B.
W83-04144

2I. Water In Plants

WATER CONSERVATION BY OPTIMAL IRRIGATION SCHEDULING BASED ON CORN DYNAMIC GROWTH MODEL,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 3F.
W83-03917

THE INFLUENCE OF WATER AVAILABILITY ON WINTER WHEAT YIELDS,
Kansas Agricultural Experiment Station, Manhattan. Evapotranspiration Lab.
For primary bibliographic entry see Field 3F.
W83-04102

WATER CONSERVATION WITH URBAN LANDSCAPE PLANTS,
Texas Water Resources Inst., College Station.
For primary bibliographic entry see Field 3D.
W83-04140

DROUGHT HARDENING OF CROP PLANTS,
Minnesota Univ., St. Paul. Dept. of Horticultural Science and Landscape Architecture.
O. Lee-Stadelmann, and E. J. Stadelmann.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105485, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Minnesota, St. Paul, August 1983. 19 p, 1 Fig, 3 Tab, 7 Ref. OWRT A-047-MINN(1).

Descriptors: *Osmoregulation, *Drought hardening, *Drought resistance, *Water stress, Crop plant, Water stress, Recovery, Osmotic adjustment, Peas, Beans.

The relation between drought hardiness and osmoregulation in Pisum sativum (pea) was studied by using pressure volume curve technique with the Richter diagram (relative water content vs. inverse leaf water potential). Two additional water relation parameters (bulk elastic modulus of the leaf and structure coefficient) can be derived from this diagram which could not be obtained from the usual pressure volume curves. Turgor pressure at water saturation and the leaf water potential at turgor loss point are obtained by regression analysis for the individual leaves. Their values for control and drought hardened plants are used to detect osmoregulation. Lower osmotic potentials after removal of water stress indicates osmoregulation (osmotic adjustment). Ten days of water stress during early stages of development followed by rewatering during a prolonged period resulted in decreased osmotic potential, that is higher drought resistance. The elasticity of the cell wall seems to be also an important parameter for drought resistance. A formula was derived to express for the first time mathematically the relation between cell wall elasticity and cell turgor pressure. The formula was applied to evaluate cell wall elasticity in bean leaves. Higher cell was elasticity was found in leaves with higher drought resistance, while osmoregulation was absent. In drought hardened pea plants osmoregulation combined with changes in cell wall elasticity seems to be responsible for drought resistance.
W83-04150

2J. Erosion and Sedimentation

SEDIMENTOLOGY OF ERECT VEGETAL FILTERS,
Georgia Univ., Athens. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 8B.
W83-03865

SOIL EROSION SIMULATION ON SMALL WATERSHEDS: A MODIFIED ANSWERS MODEL,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
S. W. Parks, J. K. Mitchell, and J. N. Scarborough.
Transactions of the ASAE, Vol 25, No 6, p 1581-1588, November/December, 1982. 7 Fig, 2 Tab, 26 Ref.

Descriptors: *Soil erosion, *Small watersheds, *Simulation analysis, Mathematical studies, Sediment transport, Sedimentation, Agricultural watersheds, Mathematical models, Erosion rates.

A physically-based soil erosion and sediment transport model whose input parameters may be determined from available information has been developed. This single-event, distributed parameter model, which is based on a fundamental erosion concept, considers typical upland erosion and sedimentation processes of splash erosion, flow erosion, sediment transporation, and deposition. Channel erosion is also included. Total erosion rates are assumed to be the sum of the splash and flow erosion or deposition rates. The model was incorporated with the ANSWERS hydrologic model and tested with data from two small agricultural watersheds of less 10 hectares in area. Hydrologic and sediment discharge simulation results from the model were in agreement with observed data. The model was shown to be applicable to an evaluation not only of temporal variations in sediment yield, but also of spatial variations in net soil erosion contributing sediment yield from a watershed. Further reasearch is needed before the model can be applied to ungaged situations. (Carroll-FRC)
W83-03963

RELATIONSHIP OF THE NATURE OF SUSPENDED CLAY MINERALS TO HYDROLOGIC CONDITIONS,
Oregon State Univ., Corvallis. Dept. of Soil Science.
D. Laird, and M. E. Harward.
Journal of Environmental Quality, Vol 11, No 3, p 433-436, 1982. 6 Fig, 13 Ref.

Descriptors: *Suspended sediments, *Sediment transport, *Soil erosion, Mineralogy, Clays, Willamette Valley, *Oregon, Sediment sorting, Erosion, Seasonal variation.

The clay mineralogy of suspended sediments in transport was studied in a small agricultural watershed in the Willamette Valley, Oregon. Although it was expected that the sediment characteristics would change with the progression of the rainfall season as the rill-gully system developed and eroded material from the B horizon, no seasonal trend in the nature of suspended clays was observed. Instead, the character of the clay minerals depended on the nature of the hydrological event. High-sediment-yield storms with fast-rising hydrographs consistently contained clays which were similar to those of the upper horizons of the watershed soils. Preferential clay mineral enrichment was seen during low-sediment-yield events or during low flow conditions following a major event. Sediments transported during the low-energy events were of the type which is more easily dispersed, for example, well-organized kaolinite and smectite. Clays that were depleted in the low-energy events, such as chlorite intergrades, were generally associated with sesquioxide coatings and gels. This selection pheonomenon was attributed to selective dispersion combined with preferential settling of nondispersed materials. (Cassar-FRC)
W83-03966

SIMULATION OF SOIL EROSION FROM WINTER RUNOFF IN THE PALOUSE PRAIRIE,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
K. H. Yoo, and M. Molnau.
Transactions of the ASAE, Vol 25, No 6, p 1628-1636, November/December, 1982. 3 Fig, 6 Tab, 26 Ref.

Descriptors: *Simulation analysis, *Rainfall-runoff relationships, *Soil erosion, Erosion, Agricultural

watersheds, Mathematical studies, Snowmelt, Channel erosion, Small watersheds, Prairies, Rainfall impact, Overland flow, *Pacific Northwest U.S.

A soil erosion model superimposed on a watershed hydrology model was developed and tested to aid the development of a planning framework for both erosion and watershed studies in the Palouse prairie of the Pacific Northwest, where soil loss from agricultural lands is a severe problem. The watershed model used was the USDAHL model, revised to better fit the Palouse conditions through the addition of a snowmelt routine. The main factors used to calculate rill development and sheet erosion on upland areas as well as channel erosion were precipitation, overland flow, streamflow, snowmelt, organic materials (crop residues and mulches), soil properties, and soil moisture. The soil loss from each hydrologic zone is cascaded to a lower area and finally to the channel. Use of the USDAHL cascading system showed the amount and location, in terms of hydrologic zones, where erosion and deposition occur. Application of the simulation model to two test watersheds showed that upland erosion was the dominant source of soil loss for both the large and the small watershed, while channel erosion was a significant source of soil loss for the larger watershed but negligible for the smaller watershed. Annual, monthly, and most daily simulated soil losses were found to be acceptable when compared with observed values, but some daily simulations did not show good correspondence to observed values. Better definition of the simulation components of both the runoff and erosion models will facilitate the use of the erosion model for evaluation or identification of soil erosion problems and for support of other erosion related studies. (Carroll-FRC)
W83-03973

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN: II. FLUVIAL SEDIMENTS,
Department of Agriculture, Guelph (Ontario). Inst. of Pedology.
For primary bibliographic entry see Field 5B.
W83-03987

SEDIMENT AND CHANNEL-GEOMETRY INVESTIGATIONS FOR THE KANSAS RIVER BANK-STABILIZATION STUDY, KANSAS, NEBRASKA, AND COLORADO,
Geological Survey, Lawrence, KS. Water Resources Div.
W. R. Osterkamp, R. E. Curtis, Jr., and H. G. Crowther.
Open-File Report 81-128 (WRI), 1982. 72 p, 25 Fig, 5 Tab, 13 Ref.

Descriptors: *Fluvial sediments, *Sediment yield, *Unstable channels, *Regulated flow, Streamflow, Reservoirs, Bank stabilization, Suspended sediment, Particle size, Stage-discharge relations, Degradation, *Kansas River, Kansas, Nebraska, Colorado.

Analysis of hydrologic data from the Kansas River basin suggests that the channels of the lower Solomon, Saline, and Smoky Hill Rivers have narrowed and stabilized as a result of construction of upstream reservoirs. The Kansas River channel, however, remains relatively unstable and locally active. Streamflow regulation and sediment trapping by reservoirs are possible causes of changes occurring at various Kansas River sites. An inferred deficiency of the suspended-sediment load, however, is likely to cause continuing instability. Suspended sediment in the Kansas River apparently is too sparse to form and maintain stable alluvial banks. The deficiency probably results in an increase of bed material movement, general channel widening, and local braiding. Significant channel degradation is lacking at most sites, but may occur in response to long-term (decades-to-centuries) regulation. Recent degradation near Bonner Springs, Kans., may be the result of sand and gravel removal. Any imposed changes that shorten the channel or reduce the suspended-sediment discharge of the Kansas River are expected to cause additional channel instability. (USGS)
W83-04008

THE MECHANISM OF RAINDROP SPLASH ON SOIL SURFACES,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
M. M. Al-Durrah, and J. M. Bradford.
Soil Science Society of America Journal, Vol 46, No 5, p 1086-1090, September/October, 1982. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Rainfall intensity, *Mathematical equations, Soil types, Precipitation intensity, Splash, Silt, Clay, Loam, Erosion, Soil mechanics.

High-speed photography was used to photograph splash from raindrops impacting various soil materials having variable water potential, bulk density, and shear strength values. From the results of high-speed photography and from soil mechanics principles, a mechanism of splash due to raindrops impacting onto saturated soil surfaces is proposed. A unique relationship between splash angle and soil strength as measured by the fall-cone device existed for six midwestern US soils. However, splash weight was not a unique function of splash angle for all soils. The explanation for this phenomenon is that under the impact of a high velocity, single waterdrop soil fails under an undrained condition. The volume of soil in the cavity created by the compression forces (only) of the waterdrop is offset by an equal volume of soil in the bulge developed around the perimeter of the depression. The greater the depth of waterdrop penetration (or compression), the larger the bulge volume. As the bulge volume increases, the splash angle increases. Thus a unique relationship was experimentally found between splash angle and strength. It is assumed that splash angle is a function of depth of raindrop compression and bulge volume, and strength is a function of cone penetration. Splash weight is related not only to the process of soil compression by waterdrop impact but also to the process of detachment due to lateral water flow across the cavity boundary. It is concluded that the total soil shearing resistance estimated by the fall-cone device and the actual resistance of the soil to the jetting water are probably not equal. (Baker-FRC)
W83-04034

QUANTIFICATION OF SOIL LOSS AND SEDIMENT PRODUCED FROM ERODED LAND,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
D. T. Lewis, and M. J. Lepele.
Soil Science Society of America Journal, Vol 46, No 2, p 369-372, March/April, 1982. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Erosion, *Nonpoint pollution sources, Soil loss, Water pollution sources, Sediment transport, Suspended sediment, Wymore series, *Nebraska.

Quantification was made of soil eroded from slopes and sediment added to stream systems as non-point pollution from a small watershed in southeastern Nebraska. The watershed selected for study was within delineation of severely eroded loessial soils. Calculations of soil loss were based on horizonation and clay distribution in eroded pedons as compared to slightly eroded pedons in the same soil series. Thickness and areal extent of soil loss were used to calculate weight and volume of soil moved from the slopes as well as volume and weight of sediment that remained near its source on the landscape. Amount of soil eroded minus that remaining in local storage suggested an amount added from the watershed as non-point sediment pollution in streams. The method described suggests a way in which soil survey mapping units may be characterized in order to quantify the amount of sediment in storage on the landscape and in stream systems due to past erosion of agricultural land. Doing so will expose the extensive erosion of good agricultural lands and the sediment added to the non-point pollution load. (Baker-FRC)
W83-04037

A LABORATORY METHOD FOR PREDICTING THE SIZE DISTRIBUTION OF SEDIMENT ERODED FROM SURFACE SOILS,
Agricultural Research Service Oxford, MS. Sedimentation Lab.
F. E. Rhoton, L. D. Meyer, and F. D. Whisler.
Soil Science Society of America Journal, Vol 46, No 6, p 1259-1263, November/December, 1982. 1 Fig, 6 Tab, 10 Ref.

Descriptors: Water management, *Soil properties, Water conservation, Soil conservation, Conservation, Texture, Aggregates, Soil aggregates, Rainfall, Runoff, Sand, *Sediment size, *Soil erosion, Mississippi, Iowa.

A study was undertaken to improve the methodology of the exploratory study and to determine if the laboratory method developed to reproduce size distributions of sediment eroded from field plots during simulated rainstorms could be used to duplicate sediment size distributions during such studies on soils with widely differing inherent characteristics. Using samples of surface soil from the field plots, sediment size data were generated in the laboratory by agitating soil suspensions on an orbital shaker after wetting the sample under tension. Once agitated, the samples were separated into 10 size groups ranging from greater than 1,000 to less than 4 micrometers. Soils high in sand and silt produced laboratory and field curves which were quite similar, but curves from soils high in clay and organic matter were less similar. Results from the 17 soils studied indicate that laboratory generated sediment size data can be used to predict size distributions of sediment eroded by simulated rainfall from interrill areas. (Baker-FRC)
W83-04067

HISTORIC CHANGES IN AN URBAN WATERSHED DETERMINED BY POLLEN AND GEOCHEMICAL ANALYSES OF LAKE SEDIMENT,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W83-04110

APPLICATION OF AERIAL PHOTOGRAPHIC AND COMPUTER ANALYSIS TO THE USLE FOR AREAWIDE EROSION STUDIES,
Texas Christian Univ., Fort Worth. Dept. of Geology.
K. M. Morgan, and R. Nalepa.
Journal of Soil and Water Conservation, Vol 37, No 6, p 347-350, November/December, 1982. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Soil erosion, *Photography, *Land use, Erosion, Remote sensing, Aerial photography, Quil Miller Creek, *Texas, Watersheds, Infrared imagery, Urban watersheds, Maps.

Problem erosion areas were identified in the 65 sq km Quil Miller Creek watershed, near Dallas-Fort Worth, Texas, using photointerpretation of color infrared aerial photographs, the Universal Soil Loss Equation, and a computerized land information system. Average soil loss for the area was 6 metric tons per ha per year, computed by field studies, and 5.6 metric tons per ha per year using photointerpretation techniques. Problem areas, defined as those with soil loss at least twice the acceptable 7-11 metric tons per ha per year for this county, were found in 75 cells, comprising 7% of the watershed (June 1980). Average soil losses in the critical areas were 60 metric tons per ha per year. Most were urban construction sites. Monitoring a year later in June 1981 showed an increase to 94 problem area cells in the rapidly urbanizing watershed. (Cassar-FRC)
W83-04185

2K. Chemical Processes

MOBILITY THROUGH SOILS OF CERTAIN HEAVY METALS IN GEOTHERMAL BRINE WATER,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
For primary bibliographic entry see Field 5B.
W83-03896

ESTIMATING THE POTENTIAL FOR OCHRE CLOGGING BEFORE INSTALLING DRAINS,
Agricultural Research and Education Center, Lake Alfred, FL.
For primary bibliographic entry see Field 4A.
W83-03975

HYDROGEOLOGIC AND GEOCHEMICAL STUDIES OF SELECTED NATURAL RADIOISOTOPES AND BARIUM IN GROUNDWATER IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
R. H. Gilkeson, K. Cartwright, J. B. Cowart, and R. B. Holtzman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-258426, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Center Research Report No 180, Univ. of Illinois, Urbana-Champaign, May 1983. 97 p, 13 Fig, 3 Tab, 60 Ref. OWRT B-108-ILL(1), 14-34-0001-8082.

Descriptors: *Aquifer properties, *Barite, *Barium, *Chemical properties, *Glacial events, *Groundwater, *Radium, *Radon, *Sedimentary rocks, *Sulfate, *Uranium, *Thorium.

Dissolved concentration of the natural radioisotopes super 222Rn, super 226Ra, super 228Ra, super 230Th, super 232Th, super 234U, and super 238U and the element Ba super 2+ were investigated in a study of high concentrations of super 226Ra, super 228Ra, adn Ba super 2+ in groundwater from the Cambrian and Ordivician bedrock of northern Illinois. The high radium and barium concentrations are present in the major aquifers - the sandstone bedrock. Therefore, remedial well construction measures will not lower the concentrations. The combined concentrations of super 226Ra and super 228Ra range from 2.3 to 50.2 pCi/L; the majority of analyses exceed the drinking water regulations of 50.0 pCi/L. The super 226Ra/super 228Ra activity ratio range from 0.2 to 41.0; a super 226Ra analysis has no validity for predicting the super 228Ra concentration. Important controls on dissolved super 226Ra concentrations are secondary U on the sandstone matrix and the ionic strength of groundwater. The distribution of accessory minerals that contain super 232Th is believed to be an important control on dissolved super 228Ra concentrations. Locally the dissolved super 226Ra and super 228Ra concentrations are affected by dissolution-precipitation of secondary barite. Dissolved concentrations of super 222Rn and U are less than proposed drinking water regulations. The extreme enrichment in super 234U that occurs widespread in groundwater from the Cambrian and Ordovician bedrock is unique and problematic. The enrichment may reflect recharge of uranium to the bedrock by glacial processes. Dissolved Ba super 2+ concentrations range from 0.01 to 22.4 mg/L. The high Ba super 2; concentrations occur in groundwater that is depleted in dissolved S0 sub 4 2-by anaerobic microbial reactions. A map presents the distribution of Ba super 2; in groundwater from the Cambrian and Ordovician bedrock in northeaster Illinois.
W83-03989

ISOTOPE HYDROLOGY OF A BASIN AND RANGE GEOTHERMAL SYSTEM,
Nevada Univ. System, Reno. Desert Research Inst.
R. L. Jacobson, N. L. Ingraham, and M. E. Campana.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265074, Price codes: A02 in paper copy, A01 in microfiche. Publication No 41087, August 1983. 18 p, 6 Fig, 3 Tab, 12 Ref. OWRT A-098-NEV(1), 14-34-0001-1130.

Descriptors: Stable isotopes, Springs, *Geothermal resources, *Groundwater recharge, Groundwater movement, *Isotope studies, Chemical properties, *Nevada, Dixie Valley.

Almost 100 stable isotopic samples were collected from rain, snow, streams, wells, and hot and cold springs at the Dixie Valley geothermal system. The mountain stream water has a deuterium composition of about -113 degrees/oo (SMOW) and is probably not a major mechanism for recharging the cool groundwater which has a deuterium composition of about -127 deg/oo or the hot spring water with -130 deg/oo. A local meteoric water line was calculated to be variation of D = 5.8 (variation of super 18 0) -25, and the precipitation samples ranged in variation of D between -50 deg/oo and -150 deg/oo, sufficient to produce the isotopic composition of all of the water in Dixie Valley including the hot springs. The four hot springs are isotopically similar and chemically dissimilar, indicating similar recharge environments but differing flowpaths. No groundwater sample contained measurable tritium (<5TU), and the super 14C results are inconclusive. This is because the variation of super 13C values of both the rock carbon and the soil carbon are unknown in this desert environment. Depending upon the variation of super 13C correction factors used, the super 14C groundwater ages are approximately between 2000 and 10,000 years B.P. This is based on 10 water samples and indicate that at least the younger of these waters may be recharged under present day meteoric conditions. An attempt was made to determine the variation of D variation with elevation. The results were inconclusive due at least in part to the melting of the snowpack during sampling.
W83-04000

CONTINENTAL-SCALE VARIATIONS IN PRECIPITATION CHEMISTRY,
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
J. W. Munger, and S. J. Eisenreich.
Environmental Science and Technology, Vol 17, No 1, p 32A-42A, January, 1983. 8 Fig, 4 Tab, 107 Ref.

Descriptors: *Distribution patterns, *Trace metals, *Chemistry of precipitation, *Isohyets, *Fate of pollutants, *Air pollution, *Precipitation, *Ions, Heavy metals, Trace elements, Chemical precipitation, Water pollution sources, Continental hydrology, Cations, Anions, Nitrogen compounds, Sulfur compounds.

Data on precipitation chemistry in North America have been used to generate isopleth maps of ion levels in precipitation to identify regional patterns of major ions and trace metals. Results showed that precipitation chemistry is dominated by local and regional land use patterns and proximity to antropogenic emissions. Acidity in precipitation is highest where emissions of precursor anthropogenic gases are highest and levels of soil neutralizing components are lowest. The semi-arid plains east of the Rocky Mountains are a major source of calcium, magnesium and potassium cations. Ammonium levels are high over central North America due to agricultural activities. Nitrate and sulfate are high near industrial sections of the Great Lakes and the northeast. Sea salt appears to be the main source of sodium and chlorine ions. Levels of lead, zinc and iron are high in atmospheres of urban-industrial areas. Factors controling the strength of these ions and metals may alter regional precipitation in the future. Changes in levels of alkaline substances would have a secondary effect on precipitation acidity. The north Atlantic coast and lower Great Lakes basin display the highest wet-deposition rates for hydrogen, nitrate and sulfate ions. Because of heavy rainfall, the Pacific Northwest has large precipitation loadings of many elements. Levels of nitrate, sulfate and ammonium ions have increased over the past 25 years. More information is needed on historical trends, the precipitation chemistry of the Gulf Coast, Mississippi delta area and southern Rocky Mountains, and the trace metal content of the precipitation of North America. (Geiger-FRC)
W83-04096

MERCURY SPECIATION IN WATER,
Alberta Environmental Center, Vegreville.
For primary bibliographic entry see Field 5B.
W83-04105

2L. Estuaries

PHYSICAL PROPERTIES OF GREAT BARRIER REEF LAGOON WATERS NEAR TOWNSVILLE. II. SEASONAL VARIATIONS,
Australian Inst. of Marine Sciences, Townsville.
E. Wolanski, M. Jones, and W. T. Williams.
Australian Journal of Marine and Freshwater Research, Vol 32, No 3, p 321-334, 1981. 9 Fig, 14 Ref.

Descriptors: *Lagoons, Water properties, *Sediments, Wind, Salinity, Water temperature, Chlorophyll A, Great Barier Reef, *Australia, Light penetration, Suspended solids, Particualte matter, *Seasonal variation, Swamps, Evaporation, Estuarine environment, Estuaries, Coastal waters, *Physical properties.

The two-dimensional distribution of several parameters was routinely measured at weekly intervals throughout 1979 along a transect between Cape Ferguson and Keeper Reef to monitor gradients of salinity and temperature both across the Great Barrier Reef Lagoon and through the water column. The major part of the research dealt with seasonal fluctuations and interrelations between the measured variables, but evidence was also found relating to the possible occurrence of an inverse estuarine circulation in the lagoon. A shallow summer thermocline was frequently observed in offshore waters in the dry season and in calm weather. As a result of evaporation from the lagoon and adjoining mangrove swamps during the dry season, an inverse estuarine circulation can exist when high salinity, sediment-rich, nearshore waters sink below the less saline offshore waters. Only in nearshore waters were the bottom sediments strongly entrained in the water column during strong winds, principally occurring the winter. (Baker-FRC)
W83-03880

THE USE OF LANDSAT MSS DIGITAL DATA IN WATER QUALITY MAPPING OF THE NEUSE RIVER ESTUARY, N. C.,
North Carolina State Univ. at Raleigh.
For primary bibliographic entry see Field 7C.
W83-03918

SEDIMENT FRACTIONATION OF CU, NI, ZN, CR, MN, AND FE IN ONE EXPERIMENTAL AND THREE NATURAL MARSHES,
Nebraska Univ.-Lincoln. Inst. of Agriculture and Natural Resources.
C. W. Lindau, and L. R. Hossner.
Journal of Environmental Quality, Vol 11, No 3, p 540-545, 1982. 1 Fig, 3 Tab, 20 Ref.

Descriptors: *Marshes, *Metals, *Sediments, Tidal marshes, Dredging, *Salt marshes, Galveston, *Texas, Heavy metals, Organic matter, Estuaries, Fate of pollutants.

An experimental intertidal salt marsh, constructed with dredged material from the Gulf Intracoastal Waterway near Galveston, Texas, was compared with three nearby marshes of similar mineralogical composition. Substrate concentrations of the metals (micrograms per g) in the four sites were: Cu, 5.1-13.4; Ni, 2.7-14.1; Zn, 5.6-61.5; Cr, 9.4-40.2; Mn, 30-263; and Fe, 3200-18,700. Generally, the metals levels were highest in the lowest elevations (0.20) sampled. Fractionation studies showed that Cu, Ni, Zn, and Cr were partitioned in a similar way in both natural and experimental marshes. Micronutrients and heavy metal concentrations in the exchangeable and water-soluble fraction were low compared with other fractions. About 30% of the total substrate Cu, Ni, and Zn was associated with the organic matter-sulfide fraction. About 53% of the experimental marsh Mn substrate content was associated with the easily reducible fraction, compared with the natural marsh's 11%. Iron associated with the organic matter-sulfide fraction of the experimental marsh was about 10% lower than the natural marsh samples. About 30% of the experimental marsh Fe was associated with the Fe oxides, compared with an average of 18% for the natural marshes. These differences may be the

result of the differences in age and stage of development of the two types of marshes. (Cassar-FRC)
W83-03968

WATER RESOURCES DEVELOPMENT OF PRAIRIE POTHOLE LAKES IN NORTH DAKOTA: SECONDARY PRODUCTION,
North Dakota State Univ., Fargo. Dept. of Zoology.
J. J. Peterka, and W. D. Wiedenheft.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265124, Price codes: A04 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State University, Fargo, August 1983. 47 p, 9 Fig, 7 Tab, 12 Ref, 1 Append. OWRT A-073-NDAK(1), 14-34-0001-1136.

Descriptors: *Salamanders, Larvae, Biomass, *Secondary productivity, Wetlands, Life history cycles, *North Dakota, *Pothole lakes, Water pollution effects.

The intent of this study was to investigate the secondary production and biology of salamanders (Ambystoma tigrinum) in prairie pothole lakes. The life-forms found were 1) young-of-the-year (larvae from time of hatching to end of the growing season), 2) neotenics (larvae which had over wintered), and 3) adults. In the three lakes studied, maximum production of salamanders (young-of-the-year) ranged from 0.4 to 2.0 kg/ha per day from August to mid-September. Maximum biomas of salamanders was reached in August to mid-September and ranged from 80 to 180 kg/ha. By late September, average weights of young-of-the-year ranged from 60 to 130 g wet weight. Salamander eggs were first observed in early May and hatching occurred by late May. In two of the lakes, only adults were captured in early May; in the third lake both adults and neotenics were captured in early May. Adults and neotenics were not captured after late July. Apparently, only adults reproduced, and their population estimates made in April and early May ranged from fewer than 5 in one lake to about 1000/ha in another. Trends in biomass followed trends in numbers with the lowest biomass occurring in the spring and the peak biomass occurring in late July-mid September and a low biomass by October.
W83-04005

VARIATIONS OF THE FRASER RIVER PLUME AND THEIR RELATIONSHIP TO FORCING BY TIDE, WIND AND DISCHARGE,
British Columbia Univ., Vancouver. Dept. of Oceanography.
L. Royer, and W. J. Emery.
Atmosphere-Ocean, Vol 20, No 4, p 357-372, 1982. 7 Fig, 3 Tab, 9 Ref.

Descriptors: *Plumes, *Spatial distribution, *Temporal distribution, Distribution, Variations, Fraser River, Rivers, Tidal rivers, Tidal hydraulics, Tidal currents, Water currents, Waves, Wind.

Temporal and spatial variations of the Fraser River Plume in the central Strait of Georgia are monitored by continuous salinity sampling of the engine cooling water on two ferry boats. Comparisons between time series of average salinity, maximum salinity gradient and river discharge demonstrate that, for both northern and southern ferry sections, low salinities and high horizontal salinity gradients correspond to peaks in the river discharge. In general the salinity increases along each section towards Vancouver Island. In terms of daily variance the plume appears to progress towards Vancouver Island during the June increase in discharge. No such progression is seen in the southern section. In terms of frequency, possible wind and discharge contributions to plume variability are well separated. Cross-correlations and cross-spectra between the plume characteristics and the along-strait wind are compatible with the along-strait advection of the plume. A positive wind will drive the plume to the northwest, raising the average salinity and lowering the salinity gradient at the southern section. At the same time this advection will sharpen the salinity gradient at the northern section. A linear combination of the effects of wind and discharge was found to substantially improve the correlations between plume characteristics and the driving forces. The harmonic analysis of eight tidal constituents confirmed the combined effects of tidal advection and tidal modulation of the river discharge. During ebb-tide, tidal currents advect the plume towards the southern section, and the slack tide allows maximum river discharge. For a flood-tide the reverse is true, so that while the tidal currents move the plume northward, the tide is gradually restricting the river outflow. For the northern section, the two processes oppose each other, leading to uncertain statistical results. (Baker-FRC)
W83-04117

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

BIPHASE TURBINE FOR REVERSE OSMOSIS DESALINATION,
Transamerica Delaval, Inc., Santa Monica, CA. Biphase Energy Systems.
For primary bibliographic entry see Field 8C.
W83-03910

SOLAR POWERED ELECTRODIALYSIS - PART II,
Ionics, Inc., Watertown, MA.
J. E. Lundstrom, M. M. Socha, and J. D. Lynch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256784, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, April 1983. 107 p, 53 Fig, 17 Tab. OWRT C-90305-D(No 9532)(1), OWRT 14-34-0001-9532.

Descriptors: *Electrodialysis, *Solar power, *Desalination plants, Brackish water, *Design, Water supply, *Cost estimates, Costs, Wells.

The critical components in the design of a solar-powered, electrodialysis (SPED) plant have been evaluated and technology developed to combine ED equipment with a photovoltaic (PV) array. The plant design developed in Part II is simplified from the Part I design in three areas. First, the system uses a flat-panel PV array rather than PV concentrators. Second, the system voltage is maintained at the voltage corresponding to the peak power output of the array which is essentially independent of the level of solar insolation. The third simplification is in the flow diagram for the plant where the number of pumps and variable flow valves has been reduced to two of each. In areas of high solar insolation such as in the southwestern states, a SPED plant can be expected to produce of the order of 190 cubic meters of fresh water from a surface, brackish water source per year per square meter of array. If the source is ground water, some of the power is consumed by the well pump and the production is reduced. In the case studied, the water was raised from a 60 meter well and the production of fresh water was about 25-30% less. Even with a well, however, the water cost can be less than $1.85 per cubic meter of fresh water. The proposed system is expected to provide a reliable supply of fresh water from a brackish water source with minimum maintenance. In certain applications where grid power is unavailable and fuel costs exceed $.40 per liter, the solar-powered plant is expected to provide lower cost water today.
W83-03921

THE EFFECT OF WATER PRETREATMENT CHEMICALS ON THE PERFORMANCE AND DURABILITY OF REVERSE OSMOSIS MEMBRANES,
California Univ., Los Angeles. Dept. of Chemical, Nuclear, and Thermal Engineering.
J. W. McCutchan, J. Glater, S. McCray, M. Zachariah, and K. Nobe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105402, Price codes: A09 in paper copy, A01 in microfiche. Completion Report, April 1983. 185 p, 66 Fig, 11 Tab, 64 Ref, 1 Append. OWRT C-00201-D, (No 0470)(1).

Descriptors: *Reverse osmosis, *Cellulose acetate membranes, *Polyamide membranes, Chemical disinfectants, Chlorine, Bromine, Iodine, Chlorine dioxide, Bromine chloride, Ozone, Hydrolysis, Membrane damage, Water flux, Salt rejection, Acetyl, Pretreatment, *Desalination, Wastewater treatment.

Performances of several commercial reverse osmosis membranes, cellulose acetate, aromatic polyamide and two thin film composite membranes, were examined when exposed to halogen disinfectants and ozone. Polyamide and thin film composite membranes failed when exposed to chlorine, chlorine dioxide, bromine and bromine chlorine. Cellulose acetate membranes of varying acetyl contents were resistant to halogen disinfectants except for some membrane deterioration at low and high pH levels. The latter has been ascribed to membrane hydrolysis rather than halogen attack. All membranes were severely damaged when exposed to ozone, but were resistant to iodine. Cellulose acetate membranes were hydrolyzed at high and low pH levels causing membrane failure. Changes in water and salt fluxes with exposure time at various temperature and pH levels suggest the greater importance of salt-water coupling in salt transport than in water transport. Acetyl content of membranes also affects transport rates.
W83-04143

A STUDY OF ADSORPTION OF COLLOIDS BY POLYMER SURFACES FOR PRETREATMENT OF WATER,
Missouri Univ.-Rolla.
S. Friberg, and H. Yasuda.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105451, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, June 1983. 89 p, 31 Fig, 10 Tab, 102 Ref. OWRT C-80330-S(No 9410)(1).

Descriptors: *Adsorption, Coagulation, *Colloids, Electrochemistry, Filter-media, Films, Polyelectrolytes, Polymers, *Pretreatment of water, Proteins, Silica, Polymer surfaces, Surfactants, *Desalination processes, Wastewater treatment.

The basic principle applied to remove colloids from sea-water to be rendered for membrane desalination processes, such as reverse osmosis and electrodialysis, etc., is the adsorption of colloids which are negatively charged by the positively charged polymer surfaces. A simple model for seawater was used in which silica and iron represented the inorganic colloids, and sodium dodecylsulfate, anionic surfactant, and whey protein the organic colloids. As the adsorbing surfaces, the surfaces of polypropylene films were rendered cationic by 1) hydrophobic implantation of cationic surfactant, and 2) surface grafting of 2-vinyl pyridine via activation of surface by argon plasma treatment. The grafted vinyl pyridine was quartenized in the washing process to form positively charged surface. The grafted polypropylene showed a strong adsorption of the anionic surfactant, and whey protein and their adsorption characteristics were found to be roughly proportional to the surface charge density. Because of adsorption equilibrium, the near complete removal of colloids by the adsorption technique cannot be achieved. The attempt to utilize electrically charged ultrathin layer coated metal surface has lead to discovery of an efficient removal method which utilizes the spot corrosion of aluminum in presence of chloride ion and Galvanic potential. The silica content was reduced from 100 ppm to about 5 ppm. The corresponding reduction of iron concentration was from 2 ppm to 0.05 ppm.
W83-04147

FINAL PRETREATMENT FILTERS FOR REVERSE OSMOSIS DESALINATION,
Rohm and Haas Co., Spring House, PA.
P. G. Cartier, and R. R. Rowe.

Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105600, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, (1983). 92 p, 3 Fig, 19 Tab, 9 Ref, 1 Append. OWRT C-90239-D(No 0417)(1).

Descriptors: *Pretreatment, *Reverse osmosis, *Ion exchange, *Filtration, Water purification, *Desalination, Water treatment, *Ultrafine ion exchange, *Precoat filtration, Floc.

The objective of this research was to demonstrate that filter media containing ultrafine ion exchange resins(UFIER) can reduce the SDI of municipally treated surface water to 3 or less and serve as a final filter to protect RO membranes. The feasibility of using UFIER floc as a 'bound flocculant' was demonstrated on a small commercial precoat filtration system. SDI in the 1-2 range could be maintained for several hours. More typically, SDI of equivalent of 4 could be maintained for equivalent of 20 hours. The later results were obtained at a UFIER consumption of 1-2mg/l of water treated. This dose level is typical of that used for inline coagulation. SDI's in the 1-2 range require a dose ranging from 7-14 mg/l. Therefore, extremely low SDI will likely be costly. If pretreatment to an SDI level of 4 is desired this technique offers an alternative to inline coagulation. Further testing is recommended on two specific precoat compositions (a low SDI/short run and a moderate SDI/long run) to determine if the results on Philadelphia city water are reproducible using other feeds. A supplier of diatomaceous earth precoat filters for pretreating RO feed would be an appropriate choice for this testing.
W83-04162

DESALTING WATER IN FLORIDA,
Florida State Dept. of Environmental Regulation, Tallahassee.
G. M. Dykes.
Journal of the American Water Works Association, Vol 75, No 3, p 104-107, March, 1983. 1 Fig, 1 Tab.

Descriptors: *Brackish water, *Reverse osmosis, *Desalination, Seawater, Groundwater, *Florida, Water treatment, Membrane processes, Saline water, Potable water.

In Florida desalting of brackish groundwater has provided an alternative source of potable water, especially in coastal areas. Most of the 90 plants depend on reverse osmosis. They vary in size from a few thousand gallons per day in small camps and subdivisions to 5 million gallons per day in the cities of Sarasota and Cape Coral. Many operate at 200 psi. In some areas water treated by reverse osmosis is blended with raw water or lime-softened water. Problems of membrane fouling with finely divided limestone and iron particles during well field development and well construction have been solved by using more suitable liners and well casing materials. (Cassar-FRC)
W83-04196

3B. Water Yield Improvement

DEVELOPMENT OF GROUNDWATER ON A RETREATING BARRIER BEACH IN RELATION TO OVERWASH AND DUNE FORMATION ON CAPE COD, MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Botany.
P. J. Godfrey, and M. Stroman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255489, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 142, Massachusetts Univ., Amherst, February 1983. 43 p, 17 Fig, 3 Tab, 16 Ref. OWRT A-135-MASS(1), 14-34-0001-9023.

Descriptors: *Groundwater, *Beaches, *Dunes, *Saline water-freshwater interfaces, Wells, Subsurface waters, *Salinity, *Saline water barriers, Beach erosion, Artificial beaches, Intertidal areas, Shores, Salt marshes, Barriers, Sea water intrusion, Aquifers, Chlorophyll, Plant growth, Overland flow, *Massachusetts, Cape Cod, Ammophila.

The groundwater under a barrier beach overwashed by the Great Blizzard of 1978 on Cape Cod was studied during 1980-81. Topographic surveys were made on man-made dunes, small natural dunes, and overwash flats. Thirty-two PVC wells were installed to determine changes in water level and salinity. Soil moisture and salinity were measured at four selected locations. Water potential, leaf resistance, and chlorophyll content of Ammophila breviligulata were also measured. Results showed rapid development of a freshwater zone after dunes were initiated. The water table fluctuated with rainfall. Groundwater under man-made dunes was always fresh, while in overwash flats it varied. Groundwater salinity in the flats declined as summer rainfall increased. Water under dunes was generally less saline than under the flats. Soil salinity was high only where saline groundwater was near the surface. Ammophila was not affected by groundwater; there was no difference between high man-made dunes and low embryonic dunes in water potential of plants. Plants closer to the water table had slightly higher chlorophyll. Ammophila dunes are critical for the development of a freshwater lens under an overwashing barrier beach; the amount of freshwater held increases as the dunes grow, and the lens forms soon after a dune starts.
W83-03907

POTENTIALLY FAVORABLE AREAS FOR LARGE-YIELD WELLS IN THE RED RIVER FORMATION AND MADISON LIMESTONE IN PARTS OF MONTANA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING,
Geological Survey, Lakewood, CO. Water Resources Div.
L. M. MacCary, E. M. Cushing, and D. L. Brown.
Professional Paper 1273-E, 1983. 13 p, 14 Fig, 1 Tab, 8 Ref.

Descriptors: *Groundwater availability, *Water quality, *Confined aquifers, *Confined-water wells, Well yield, Potentiometric level, Water demand, Porosity, Resistivity, Geohydrology, *Madison Limestone, *Red River Formation, Northern Great Plains.

Extensive development of the coal in the Northern Great Plains will require large volumes of water for on-site power generation, gasification, liquefaction, and slurry-pipeline transport. Ground water from Paleozoic rocks might supply, at least temporarily, a significant part of the required water. Hydrologic and geologic criteria were used to outline potentially favorable areas for large-yield wells (more than 500 gallons per minute). Potentially favorable areas for the Red River Formation, the Madison Limestone, and for the two formations combined are given a qualitative numerical scale. Water quality is the controlling parameter, thus the areas show ground water having greater than 1-ohm-meter resistivity. Depths to the two formations, calcite saturation, water temperature and areas where wells flow are not differentiated on the numerical scale. (USGS)
W83-04011

RESIDUAL-WAX SOIL TREATMENTS FOR WATER HARVESTING,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
D. H. Fink.
Soil Science Society of America Journal, Vol 46, No 5, p 1077-1080, September/October, 1982. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Water harvesting, *Water repellent soils, Soil types, Soil water, Soil absorption capacity, Runoff, Wax, Paraffin, Watersheds, Water management, *Arizona.

A comparison was made of the weatherability of residual vs. paraffin waxes used as soil treatments for water harvesting. The effectiveness of soil prestabilization and use of antistriping agents for improving the weathering properties of the residual-wax soil treatments was also determined. Ten residual waxes and two paraffin waxes were applied to Tremant soil at three rates. The treated soils were weathered by alternately subjecting them to freeze-thaw cycling, to erosion, and to water repellency testing. The results showed that the less costly residual wax treatments were generally more weather resistant than the paraffin treatments. Generally, the antistripping agent and cellulose xanthate improved weatherability of the waxes tested. With soil prestabilization and the addition of antistripping agents, the wax application rate for most waxes on soils similar to the one tested could be reduced to 0.25 kg/sq m, which is one-fourth to one-eighth the currently recommended rate. (Baker-FRC)
W83-04038

A PROPOSED PHOTOHYDROGEOMORPHIC TECHNIQUE AS AN AID FOR FASTER EXPLORATION OF GROUNDWATER POTENTIAL AREAS IN THE INDIAN ARID ZONE,
Central Arid Zone Research Inst., Jodhpur (India).
P. C. Chatterji, and S. Singh.
Annals of Arid Zone, Vol 19, No 1-2, p 58-64, March-June, 1980. 1 Fig, 3 Ref.

Descriptors: *Groundwater potential, *Geomorphology, *Geohydrology, *Aerial photography, *Arid-zone hydrology, *Hydrologic maps, Groundwater recharge, Groundwater management, Geologic mapping, Deserts, Drainage patterns, Resources development.

Portions of the western Rajasthan desert in India are covered with a blanket of sandy alluvium, making hydrogeological studies difficult. Geophysical studies are often very time consuming and costly. Since systematic hydrogeological investigations have shown than potential aquifers of this area are directly related to geomorphic characteristics, geomorphic studies were carried out using an economical photo-hydrogeomorphic technique. Aerial photographs at three scales were taken to identify gradient, altitude, drainage patterns, nature and thickness of sediments, erosional and depositional features, stable and unstable slopes, rocky strata, and associated joints and fractures. Nine geomorphic units and two water potential zones (the recharge zone and the recharged zone) were identified. In the recharge zone, the surface water potential could be developed to augment the groundwater potential of the adjoining areas, while in the recharged zone, the already exploited groundwater potentials should be rationally utilized to avoid any adverse effects on irrigated lands. (Geiger-FRC)
W83-04121

3C. Use Of Water Of Impaired Quality

IONIC COMPOSITION OF GROUND WATERS IN JIND DISTRICT (HARYANA) AND THEIR SUITABILITY FOR CROP GROWTH,
Central Soil Salinity Research Inst., Karnal (India).
R. C. Sharma.
Annals of Arid Zone, Vol 19, No 1/2, p 43-50, March-June, 1980. 1 Fig, 3 Tab, 13 Ref.

Descriptors: *Irrigation water, *Saline water, *Water quality, Haryana, *India, Dissolved solids, Conductivity, Maps, Groundwater, Agriculture, Impaired water use, Anions.

Groundwater samples from the Jind district, Haryana, India, were analyzed to determine their suitability for irrigation. Results are summarized in a map, which shows water quality zones according to electrical conductivity (EC). Most of the district has groundwater of >4000 micromhos per cm, usable only with light textured soils with good drainage and salt tolerant crops. Major anions in the low salinity water were carbonate and bicarbonate. As EC increased, chloride and sulfate became the major anions. Sodium was dominant over the entire range of EC. Mg/Ca ratios varied from 9.5: at EC of 2000 to 2.3:1 at EC of 10,000 micromhos per cm. Average residual sodium carbonate concentrations were highest (2.9 me per liter) in the 1000-20000 micromhos per cm group. Farmers' experience indicated that waters <4000 micromhos per cm were generally considered of good quality for irrigation. (Cassar-FRC)
W83-03866

IMPACT OF SALINE WATER IRRIGATION ON SOME CROPS AND THEIR VARIETIES,
Orissa Univ. of Agriculture and Technology, Bhubaneswar (India). Dept. of Plants and Genetics.
M. Rai.
Annals of Arid Zone, Vol 19, No 3, p 231-237, September, 1980. 6 Fig, 3 Tab, 10 Ref.

Descriptors: *Saline water, *Irrigation water, *Salt toelrance, Water pollution effects, Impaired water use, Wheat, Barley, Sunflower, Safflower, Mustard, Oilseed crops, Grain crops.

Salt tolerance of 13 varieties each of wheat and barley and 10 each of sunflower, safflower, and Indian mustard was studied in 1973-75 in India. Irrigation waters had electrical conductivities (EC) of 0, 4, 6, 8, and 12 mmhos per cm. Germination was affected differently by salinity in each year, some crops being unaffected the first year (wheat, barley, and safflower) and most being affected the second year. Among the oilseed germination of safflower was least affected by salinity, followed by mustard and sunflower. Grain yield of wheat and barley decreased with increasing salinity. Safflower produced 145% better grain yields at 12 mmhos per cm irrigation than the control. Indian mustard produced a maximum yield (137% of control) at 8 mmhos per cum and 110% of control at 12 mmhos per cm. The most salt tolerant varieties were: wheat, HD 15553 in germination and HD2009 in grain yield; barley, Amber; sunflower, EC82362 in grain yield per plant, and EC75272 in grain yield per unit area, and EC97923 in germination; safflower, IC11842 in grain yield and SF5 in germination; and mustard, AppPod-7 in grain yield per plant and T59 in grain yield per unit area and germination. (Cassar-FRC)
W83-03885

A STUDY ON THE EFFECT OF RESIDUAL SODIUM CARBONATE OF IRRIGATION WATER ON THE PROPERTIES OF A LOAMY SAND SOIL AND ON YIELD AND NUTRIENT UPTAKE BY WHEAT AND BARLEY,
S.K.N. Coll. of Agriculture, Jobner (India).
P. Lal, G. C. Mali, and K. S. Singh.
Annals of Arid Zone, Vol 19, No 4, p 395-397, December, 1980. 3 Tab, 5 Ref.

Descriptors: *Sodium carbonate, *Nutrients, *Saline water, Irrigation water, Wheat, Barley, Crop yield, Grain crops, Jobner, *India, Soil properties, Water quality, Water pollution effects, Dissolved solids.

Wheat and barley were grown in pots containing loamy sand soil, irrigated with 5 types of water having the same total concentration (20 meq per liter) but different residual sodium carbonate (RSC) levels (0, 2.5, 5.0, 7.5, and 9.5 meq per liter). Grain yields of both crops decreased with increasing residual sodium carbonate. Grain yield (g per pot) were: wheat, 9.97 at 0 RSC and 7.92 at 9.5 meq per liter RSC; barley, 9.5 at 0 RSC and 8.1 at 9.5 meq per liter RSC. Uptake of phosphorus, potassium, and calcium decreased and uptake of sodium increased with increase in RSC. Electrical conductivity and hydraulic conductivity of the soil tended to decrease with an increase in RSC. (Cassar-FRC)
W83-03888

SALINITY AND TOXICITY OF BRACKISH WATERS OF ARID ZONES OF WESTERN RAJASTHAN,
Defence Lab., Jodhpur (India).
R. Gopal, T. N. Bhargava, O. P. Bhati, T. C. Tak, and P. K. Ghosh.
Annals of Arid Zone, Vol 19, No 3, p 248-250, September, 1980. 2 Tab, 2 Ref.

Descriptors: *Saline water, *Dissolved solids. *Toxocity, *Pollutant identification, Brackish water, Groundwater, Arid lands, Rajasthan, *India, Chlorides, Water analysis.

A total of 1500 groundwater samples from arid zones of western Rajasthan, India, were analyzed. Results showed that 9% of the available water in the region had <500 mg per liter total dissolved solids (TDS) and 49% had less than 2000 mg per liter TDS (considered potable). The TDS ranges (mg per liter) and the percentages of water falling into each class were: <1000, 23%; 1001-5000, 53%; 5001-10000, 19%; and above 10000, 5%. None of the samples were contaminated with As, Ba, Cd, Cr, Pb, Se, Ag, or cyanide. Fluoride concentrations were 0.3-20 mg per liter. Nitrate concentrations were 0.5-100 mg per liter. Half of the samples had F concentrations <2 mg per liter, while only 2% of samples contained nitrate levels above 50 mg per liter. (Cassar-FRC)
W83-03889

EFFECTS ON SOILS AND VEGETATION OF PLANT NUTRIENTS AND HEAVY METALS FROM WASTEWATER-TREATMENT-PLANT SLUDGES DISPOSED ON LAND,
West Virginia Univ., Morgantown. Water Research Inst.
For primary bibliographic entry see Field 5E.
W83-03905

WATER RECYCLING - RESEARCH NEEDS,
Binnie and Partners, London (England).
A. L. Downing, and G. E. Eden.
Water Science and Technology, Vol 14, No 9-11, p 1475-1480, 1982.

Descriptors: *Water reuse, *Research priorities, *Reviews, Monitoring, Quality control, Toxicity, Bacteria, Public health.

Research is needed in many diverse areas concerning the reuse of water. These many different areas are reflections of the many different potential applications of recycled water. A major objective of research is to reassure the public and those bodies of official and unofficial persons who watch over their welfare of the safety of the public water supply, no matter what the source. Research must also be aimed toward enabling the water supplier to carry out his function economically and reliably. Areas of study include epidemiological studies, animal studies, studies with bacteria or cell cultures, biodegradability tests, chemical analysis, microbiological monitoring, standards, treatment processes, industrial effluents, and administrative control. Wastewater purification to potable standard may be too costly and unnecessary for some applications of re-used water which have been proposed, including irrigation, water sports, and many industrial uses. Other general research needs include establishment of pricing policies and incentives, energy production, development of continuous monitoring systems, and alternatives to the water-carriage system for disposal of wastes. (Baker-FRC)
W83-03965

WATER RECYCLING FOR DOMESTIC AND AGRICULTURAL APPLICATIONS: STATE OF THE ART,
Water Research Commission, Pretoria (South Africa).
C. F. Schutte.
Water Science and Technology, Vol 14, No 9-11, p 1447-1463, 1982. 17 Ref.

Descriptors: *Water reuse, *Reviews, Water supply, Water supply development, Irrigation, Drinking water, Public health, Public opinion, Planning, Design criteria, Water quality, Quality control, *South Africa.

This review concentrates on the state of the art of water recycling for domestic use, including agricultural applications. The engineering, public health and quality aspects of indirect reuse, indirect recycling and direct recycling of water in domestic supplies are discussed. There appears to be very little distinction between indirect reuse of water containing effluents and recycling of reclaimed water for domestic applications. These systems must all be regarded as producing water from polluted sources. High priority should thus be given to the development of a set of quality standards for drinking water derived from these sources. The EPA has initiated the process in the United States by organization of the Airlie workshop on protocol development, while the South African Department of Health, Welfare and Pensions has published proposed directives for the recycling of water for domestic applications. Treatment technology does not seem to represent a limiting factor in the implementation of water recycling. Public support for any recycle project is of vital importance. Current recycling projects comprising advanced reclamation technology are performing exceptionally well if judged by the quality of water that is being produced. Recycling of reclaimed water for irrigation of crops and green land areas is a very successful way of using existing water supplies to the maximum or replacing freshwater supplies which could be better used for domestic and industrial applications. (Baker-FRC)
W83-03969

HEALTH RISKS ASSOCIATED WITH WATER RECYCLING,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
H. I. Shuval.
Water Science and Technology, Vol 14, No 9-11, p 1465-1474, 1982. 1 Tab, 5 Ref.

Descriptors: *Water reuse, *Public health, *Health risks, Water quality, Bacteria, Viruses, Salmonella, Sprinkler irrigation, Irrigation, Water supply development, Water supply, Water quality control.

Water recycling is one of the most promising modes of increasing water resources. The most common form of water recycling is what is often called indirect, unplanned, or covert water recycling. This form is practiced wherever surface water is extracted from rivers or lakes into which urban and industrial waste is discharged. Indirect or unplanned water recycling for agricultural purposes is very widely practiced throughout the world. In direct, planned, reuse of water there are a number of legal and moral issues involved which urge that stricter standards be met than in the cases of indirect or unplanned reuse. The earliest form of wastewater reuse was for agricultural irrigation. Municipal wastewater carries with it the full spectrum of pathogenic bacteria, viruses and parasites excreted by the population in the urban community. Direct application of partially treated municipal wastewater or sludges for salad crops or other fruits and vegetables that are eaten raw can lead to the transmission of communicable diseases to the population exposed. A number of countries have established standards regulating the use of wastewater effluent for those crops which are eaten raw and present a high degree of health risk. In many areas of the world, sprinkler irrigation is practiced for agricultural purposes. In some studies aerosolized enteric bacteria have been detected as far as 750 meters downwind from such spray irrigation plots. Enteric viruses and salmonella bacteria have been detected as far as 100 meters downwind from the fields. In industrialized areas the reuse of municipal effluents for cooling water or other purposes in industry is an attractive form of wastewater reuse. (Baker-FRC)
W83-03971

IRRIGATION WITH SIMULATED SECONDARY WASTE WATER ON TILED SOIL CROPPED TO BROMEGRASS AND CORN,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
S. A. Grant, R. J. Kunze, and G. Asrar.
Journal of Environmental Quality, Vol 11, No 3, p 442-446, 1982. 2 Fig, 9 Tab, 28 Ref.

Descriptors: *Wastewater irrigation, *Nutrients, *Tile drainage, Fate of pollutants, Irrigation, Nitrates, Phosphates, *Corn, Bromegrass, Pastures, Fertilizers, Drainage systems, Wastewater disposal, *Sprinkler irrigation, Grasses.

A synthetic secondary wastewater was applied by sprinkler irrigation to a tiled soil cropped to bromegrass and corn over a 6-year period. Application rates were 100 or 200 cm per season. Tile drainage water in the last year of the study, 1978, contained 3.3-8.5 mg per liter nitrate and 0.1-0.4 mg per liter phosphate, with the lower concentra-

tions in the grass plots. Concentrations of nitrate in various soil layers over the 270 cm soil profile were 7.8-25.8 mg per liter in grass plots and 11.4-37.5 mg per liter in corn plots. However, corn removed more nutrients than grass. Adding N fertilizer to corn significantly increased nutrient removal, but adding K fertilizer did not. Peak P and K concentrations preceded the peak tile water flow by about a half hour. (Cassar-FRC)
W83-03985

UTILIZATION OF WATER FROM THE OPEN-CAST MINES SITUATED NORTH OF LEIPZIG (DIE NUTZUNG DES WASSERS AUS DEN TAGEBAUEN NORDLICH LEIPZIGS),
Dresden Forschungszentrum Wassertechnik (German D.R.).
K. -H. Arnold.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 5, p 429-433, May, 1980. 1 Tab, 6 Ref. (No English Summary).

Descriptors: *Impaired water use, *Drinking water, *Coal mining, *Groundwater potential, Water resources development, *Water use efficiency, Mining engineering, Water quality, Iron, Chloride, *German Democratic Republic, Leipzig, Delitzsch, Open-cast mining, Geology, Economic aspects, Water pollution, Agriculture, Water treatment facilities, Construction.

At present in the German Democratic Republic, more water is removed in the course of open cast mining than is utilized by all drinking water treatment plants combined, while very little of the mining water is used for drinking. Water removed from the Delitzsch open-cast mine near Leipzig was investigated as to its possible use for drinking. Geological conditions are favorable in this area, where eocene brown coal is mined. There is no danger of high chloride levels, but a danger of agricultural pollution of the groundwater through fertilization and wastewater application does exist. Secondary pollution of surface waters that converge in the mine when it rains is also possible, and this water should be removed. Water treatment facilities must be constructed, taking into account the possibility that groundwater quality may be impaired as its level sinks. In this case, one-stage iron removal should be practiced during the first few years, followed by two-stage removal using the same facilities when iron content increases and water volume decreases. The time period during which mining water is available must also be considered when evaluating the possibility of its use for drinking. For the Leipzig/Delitzsch area, this period is at least 30-50 yr, making drinking water production economical. Analysis of raw water quality in the ring main of the Delitzsch mine revealed that the pH value was 7.4, total iron concentration was 1.3-1.4 mg/l, total manganese concentration was 0.2-0.3 mg/l, and sulfate, chloride, and nitrate levels were 181-203, 72-85, and 0.7-0.8 mg/l, respectively. The water quality prognosis for other mines in the area agreed with these results. (Gish-FRC)
W83-04061

SOME ASPECTS OF THE PRESENT STATUS OF ALGAE CULTIVATION AND THEIR APPLICATION (NEKOTORYE ASPEKTY SOVREMENNOGO SOSTOYANIYA KUL'TIVIROVANIYA VODOROSLEI I IKH PRIMENENIE),
For primary bibliographic entry see Field 5D.
W83-04073

PURIFICATION OF FAECAL WATERS COMBINED WITH ALGAL PROTEIN PRODUCTION (OCHISTVANE NA VODI S FEKALEN KHARAKTER, SUCHETANO S POLUCHAVANE NA VODORASLOV PROTEIN),
For primary bibliographic entry see Field 5D.
W83-04074

USING 'BLOWDOWN' WATER TO IRRIGATE CROPS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, L. H. Stolzy, C. A. Fox, H. J. Vaux, Jr., and I. R. Straughan.
California Agriculture, Vol 37, No 3/4, p 4-5, March/April, 1983. 4 Tab.

Descriptors: *Cooling water, *Irrigation water, *Wastewater disposal, Powerplants, Saline water, Evaporation, Ponds, Fate of pollutants, Impaired water use, Water pollution effects, Seepage, Crop yield.

Irrigating crops with blowdown from powerplant cooling systems was less expensive and resulted in less groundwater pollution than disposing of the blowdown in evaporation ponds. Crops were grown in the arid section of California under leaching conditions designed to produce the maximum adverse impact of saline water on the crops and the minimum pollution of drainage water. The concentration of total dissolved salts in irrigation water was 3000 ppm. Estimated salt emissions below a clay-lined evaporation pond (leaching fraction, 0.4) and two irrigated fields (leaching fractions, 0.2 and 0.1) were 30,000, 28,000, and 27,000 tons per year, respectively. Drainage concentrations (ppm) for the 3 treatments were 14,000, 25,000, and 48,000, respectively. Although the value of the wheat or sorghum crop would not be sufficient for a profitable farming operation, it provides an economic alternative to building evaporation ponds, which have annual costs of $24,000 to $2.5 million, depending on materials of construction. (Cassar-FRC)
W83-04112

ROLE OF MYCORRHIZAE IN LAND APPLICATION OF MUNICIPAL WASTEWATERS,
Louisiana Tech Univ., Ruston. Dept. of Agricultural Engineering.
J. W. D. Robbins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105527, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Louisiana State Univ., Baton Rouge, August 1983. 12 p, 5 Tab, 10 Ref. OWRT B-009-LA(1), 14-34-0001-6083.

Descriptors: *Municipal, *Wastewater, *Land application, Lagoon effluents, *Mycorrhizae development, Soil-water-plant relationships.

Results are presented of a field plot study aimed at developing criteria for applying municipal wastewaters (lagoon effluents) to land. Wastewater management techniques that affect the response of mycorrhizae in trees were tested. Water application rates and frequencies were varied. In all, 97 plots each initially containing 25 loblolly pine and 25 white oak tree seedlings, were studied. Tree roots were sampled and analyzed for mycorrhizal development at 7 and 16 months following initiation of plot treatments. Tree growth parameters were also made. Statistical analyses of the results failed to demonstrate significant differences among the various plot treatments for the parameters measured.
W83-04154

3D. Conservation In Domestic and Municipal Use

DROUGHT MANAGEMENT CONCEPTS: LESSONS OF THE 1976-77 U. S. DROUGHT,
For primary bibliographic entry see Field 6D.
W83-03922

WATER CONSERVATION WITH URBAN LANDSCAPE PLANTS,
Texas Water Resources Inst., College Station.
B. W. Hipp, C. Giordano, and B. Simpson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105386, Price codes: A05 in paper copy, A01 in microfiche. Completion Report No 126, August 1983. 74 p, 16 Fig, 26 Tab, 24 Ref, 1 Append. OWRT A-050-TEX(1), 14-34-0001-1146,2146

Descriptors: *Evapotranspiration, *Water use, Native plants, Consumptive water use, Irrigation, *Urban landscapes, *Texas, Lysimeters, *Water conservation.

Water shortages are a common problem in much of the southwest. Increasing urbanization and increasing population places greater demands on dwindling water supplies. Over half of the water used in urban areas of the southwest is used in the irrigation of landscapes. To help cope with increased urban water demands and low water supplies, research was conducted to gain information relative to consumptive water use by native and non-native landscape plants. Twenty weighing lysimeters were constructed and installed and plants established in the lysimeters and adjacent areas. Plants used in the study were buffalo-grass, St. Augustinegrass, cenizo, boxwood and Texas barberry. All plants are native to Texas except boxwood and St. Augustinegrass. Water use by shrubs in lysimeters was variable and not influenced by plant type during the period of establishment. (Fall 1981). During 1982, water use was influenced more by plant size than by specie or water level. Cenizo had much faster growth rate than the other shrubs in the study. Water use by container grown plants indicated that cenizo had higher water use efficiency than boxwood or Indian Hawthorn. Water use was determined for several native shrubs and of the ones compared, Texas barberry appeared to have the most promise for use in water conserving landscapes.
W83-04140

3E. Conservation In Industry

ASSESSMENT OF WATER RECYCLE AND REUSE POTENTIAL IN THE INORGANIC CHEMICALS INDUSTRY,
Versar, Inc., Springfield, VA.
A. M. Twedell, E. F. Rissmann, J. P. LeBoff, G. A. Riley, and P. A. Hillis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105626 Price codes: A10 in paper copy, A01 in microfiche. Completion Report OWRT/RU-82/17, September 1982. 207 p, 52 Fig, 28 Tab, 49 Ref OWRT C-90146-R(No 0457)(1).

Descriptors: *Water reuse, *Recycling, *Inorganic chemicals industry, Water quality, Water use efficiency, Water costs, Industrial wastes.

An assessment is presented for the current status of wastewater reuse and recycle in the inorganic chemicals industry and for recycle in future years. The emphasis of the study is directed at the major water-using segments of the industry, which account for over 88% of the industry's gross water use. Each of these segments is characterized by defining their production processes, plant locations, water quantity and quality requirements, and projected growth. The following water use components are estimated for each of the major water-using segments on a national and regional basis for the years 1980, 1985, and 2000: gross water use, recycle, consumption, withdrawal, and process discharge. Recycle estimates are based on an examination of current industry practices, water quality requirements, environmental regulations, water requirements relative to regional water supplies, economic incentives, and new and existing technologies. Water recycle in this industry was found to be limited by process specific constraints and economic feasibility considerations. Significant increases in percent recycle were projected for only three industry segments. The number of cases of water reuse was found to be small, and limited largely by plant location considerations.
W83-04164

3F. Conservation In Agriculture

FEDERAL TAX LAWS AND SOIL AND WATER CONSERVATION,
California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6E.
W83-03857

SUPPLEMENTAL IRRIGATION TO WHEAT FROM RUNOFF HARVESTED WATER UNDER DRY FARMING CONDITIONS,
Central Soil and Water Conservation Research and Training Inst., Dehra Dun (India).
G. Singh, and L. S. Bhushan.
Annals of Arid Zone, Vol 19, No 3, p 215-220, September, 1980. 1 Fig, 4 Tab, 3 Ref.

Descriptors: *Irrigation, *Wheat, *Water use efficiency, *India, Water conservation, Water harvesting, Fertilizers, Crop yield, Supplemental irrigation.

Although the subhumid region of India receives 100-200 cm of rainfall annually, 75-80% is in June-September. This pattern produces water deficiencies during the winter wheat growing season. Wheat was grown with 4 irrigation treatments: (1) no irrigation, (2) one presowing irrigation, (3) one crown root initiation stage irrigation, and (4) one presowing plus one crown root stage initiation irrigation. In the 3 years of the study wheat yield was increased by as much as 4 times by supplemental irrigation treatments as compared with the dry control. Yield improvement was greatest in the driest season, 1976-77. Water use efficiency was increased by irrigation treatments, from 7 kg grain per mm in the control to 14-16 kg grain per mm in the irrigated plots (1976-77). Fertilizer use efficiency also increased dramatically with irrigation, the greatest difference being from 3 kg grain per kg N in the control to 23 kg grain per kg N in Treatment (4) in the driest season. For the Dehradun area it is recommended that a presowing irrigation be applied to avoid evaporation and seepage losses in the storage ponds. If water is still available later in the season, a second irrigation can be applied at crown root initiation. (Cassar-FRC)
W83-03867

PLANNING FOR INCREASED CROP PRODUCTION UNDER LIMITED WATER RESOURCES IN ARID AND SEMI-ARID CONDITIONS,
Indian Council of Agricultural Research, New Delhi.
T. C. Jain.
Annals of Arid Zone, Vol 19, No 3, p 227-230, September, 1980. 2 Tab, 4 Ref.

Descriptors: *Irrigation, *Crop yields, Wheat, Barley, Grain crops, Cumin, Mustard, Taramira, Water conservation, *Arid lands, *India.

Wheat and barley crops were planted alone and with another crop (mustard, taramira, or cumin) to study yields and economic aspects under conditions of limited water resources. The experiment was conducted in loamy sand in a semiarid region of India. In all combinations there was a reduction in yield of main crops, but the yield of additional crops was good enough to compensate for the reduction in main crop. Cumin caused the greatest yield losses in the main crops. A sample irrigation schedule is given. (Cassar-FRC)
W83-03868

MOISTURE CONSERVATION EFFICIENCY OF SOME LEGUMES AND THEIR EFFECT ON THE YIELD OF RAI (BRASSICA JUNCEA COSS) UNDER RAINFED CONDITIONS,
Chandra Shekar Azad Univ. of Agriculture and Technology, Kanpur (India).
K. S. Bhatia, K. K. Srivastava, and B. Lal.
Annals of Arid Zone, Vol 19, No 1/2, p 14-18, March-June, 1980. 3 Tab, 3 Ref.

Descriptors: *Soil moisture retention, *Legumes, *Water conservation, Fallow, Rai, Moong, Urd, Cowpea, Sorghum, Crops, Crop yield, Rainfall, Cover crops, *India.

The effect on soil water conservation of planting fields with legumes in the kharif season prior to planting rai (Brassica juncea Coss) in the following rabi season was studied for two years on an alluvial sandy loam in India. The percentage of soil moisture conserved by the various treatments at harvesting of the subsequent crop were: fallow, 15.8%; urd, 12.1%; moong, 16.3%; cowpea, 10.4%; and sorghum + cowpea, 10.3%. Adding fertilizer to the legumes did not significantly affect moisture conservation. Rai yields were increased by fallow, moong, and urd treatments. (Cassar-FRC)
W83-03869

EFFECT OF DIFFERENT MULCHES ON YIELD, AND MOISTURE-USE-EFFICIENCY ON TOBACCO (NICOTIANA TABACUM),
Gujarat Agricultural Univ., Ahmedabad (India).
C. B. Shah, G. L. Maliwal, P. T. Patel, and B. P. Padhiyar.
Annals of Arid Zone, Vol 19, No 4, p 451-456, December, 1980. 4 Tab, 9 Ref.

Descriptors: *Tobacco, *Mulches, *Water use efficiency, Crop yield, Bajra stover, Water conservation, *India.

Mulching with bajra stover at 5 tons per ha immediately after establishment of tobacco seedlings on a deep loam sand was the most effective treatment for optimum water use efficiency and crop yield. Other treatments included: (1) dust, (2) polyethylene sheet, (3) wheat straw at 5 tons per ha, and (4) bajra stover at 5 tons per ha after last rain. (Cassar-FRC)
W83-03871

OPTIMUM UTILIZATION OF LIMITED WATER RESOURCES OF ARID LANDS FOR EFFICIENT CROP PRODUCTION,
Central Arid Zone Research Inst., Jodhpur (India).
H. S. Daulay, and R. P. Singh.
Annals of Arid Zone, Vol 19, No 3, p 203-213, September, 1980. 9 Tab, 3 Ref.

Descriptors: *Irrigation, *Arid lands, *Water use efficiency, Wheat, Barley, Safflower, Mustard, Legumes, *Water conservation, Fertilizers.

A crop management strategy for efficient growth of winter crops in the arid zone of India was developed by growing winter wheat, barely, mustard, safflower, and pulses under different water regimes and fertility levels on sandy loam soils. Grain/seed yields, moisture use efficiency, and water use at different growth stages were reported for several varieties of crops and low, medium, and high water regimes and fertility levels for two growing seasons. Data on yield and mositure use efficiency under conditions of limited irrigation were converted to money value of the crop at the current market price. Mustard had the highest market value (in Rs. per mm per ha), 21.3; followed by peas, 15; safflower, 12.8; barley, 12.5; wheat, 11.2; and gram, 10.7. Generally the medium fertility level was most cost efficient. (Cassar-FRC)
W83-03873

EFFECT OF ASPHALT SUB-SURFACE MOISTURE ON WATER CHARACTERISTICS AND PRODUCTIVITY OF SAND SOIL,
Central Arid Zone Research Inst., Jodhpur (India).
J. P. Gupta, and R. K. Aggarwal.
Annals of Arid Zone, Vol 19, No 4, p 445-450, December, 1980. 2 Tab, 8 Ref.

Descriptors: *Barriers, *Soil moisture retention, *Water use efficiency, Asphalt, Arid lands, Sand, Water conservation, Amobar, Evaporation, Mulches, Crop yield, Moisture profiles, Subsurface barriers, Soil-water-plant relationships.

The effects of a 2 mm thick asphalt moisture barrier (Amobar) applied about 60 cm below the surface of a sand soil were investigated with a bajra crop during the rainy seasons of 1976 and 1977. Of 200 mm of irrigation water, the soil with barrier retained 176 mm, compared with 80 mm in the control. Evaporative loss over a 30-day period after irrigation was 3-5 mm higher in barriered soil than in the control. Barriered soils contained 2-4% more moisture in the 0-15 cm layer and 2-10% more in the 15-60 cm layer than normal soils. Soil moisture tensions at 40 cm depth were generally at or below 0.1 atmosphere in barriered soils and 0.3 atmosphere in normal soils. After a 60 mm rainfall moisture storage in the barriered soil increased 40 mm more than control soil. The barrier increased mineral nitrogen in the soil after harvest by 34.6-66.7%, increased N in the grain by 22.4-32.5%, and increased uptake of N by the crop by 11.3-83.87%. Crop yields and water use efficiences were also higher in the barrier fields. Asphalt barriers are not useful in soils other than sand with good self-mulching properties or where irrigation water is saline. (Cassar-FRC)
W83-03875

PLANNING SOIL AND MOISTURE CONSERVATION IN ARID REGIONS OF RAJASTHAN,
Central Arid Zone Research Inst., Jodhpur (India).
V. C. Sharma, D. C. Joshi, and J. S. Choudhari.
Annals of Arid Zone, Vol 19, No 4, p 421-424, December, 1980. 2 Tab, 2 Ref.

Descriptors: *Water harvesting, *Soil conservation, *Farm management, Runoff, Water conservation, Agriculture, *Arid lands, Erosion control, *India, Water managment, Irrigation, Infiltration, Rajasthan.

A study of two watershed in northern Jodhpur, India, resulted in land use plans more suitable for soil and moisture conservation than the present use patterns. The Rampura watershed has deep, sandy soils, of which 107 ha is well suited and 533 ha is marginally suited for cultivation. The Balarava watershed has moderately coarse shallow soils with some rocky exposures, of which about 800 ha is well suited and 487 ha is marginally suited for cultivation. Infiltration rates are 12.1 to 28.4 cm per hour in Rampura watershed and lower (3.6 to 10.8 cm per hour) in Balarava. Moisture equivalent values are similar in soils from both watersheds. Water storage capacity is greater in deep soils in both watershed. Runoff estimations are 7 to 33 ha meter in Rampura and 18 to 118 ha meter in Balarava. It is proposed that all the uncultivable land in Rampura and over half of the uncultivable land in Balarava be used for runoff collection and direction of water to a collection point. (Cassar-FRC)
W83-03887

PREDICTING CROP PRODUCTION AS RELATED TO DROUGHT STRESS UNDER IRRIGATION,
Utah Agricultural Experiment Station, Logan.
R. J. Hanks, R. M. Hagan, R. E. Danielson, E. B. Jackson, and W. O. Pruitt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255455, Price codes: A16 in paper copy, A01 in microfiche. Utah Agricultural Experiment Station Research Report 65, (1983). 367 p, 94 Fig, 119 Tab, 40 Ref. OWRT B-176-UTAH(1), 14-34-0001-9139.

Descriptors: *Crop production, Crop yeild, *Drought, Deficit irrigation, *Irrigation requirements, Sugar beets, *Soil moisture deficiency, Evapotranspiration, Consumptive use, Soil-water-plant relationships, Soil salinity, Water quality, Soil moisture retention, Arizona, California, Colorado, Utah.

Efficient farm water management to make the best use of limited water supplies during droughts requires reliable information on crop water needs as affected by climate, weather, soil and water quality. In order to broaden the data base, a common experimental design was used to collect field data at Yuma, Arizona; Davis, California; Fort Collins, Colorado; and Logan, Utah. The sugar beet data give sucrose, fresh root and dry matter yield for five or six replicated levels of water application. Irrigations (amount and time), soil water depletion, estimated drainage, and evapotranspiration were measured by stages during the growing season. The data were used in models to evaluate the influence of water deficits on crop production, given the climatic and other site factors. Yields with total mid-season cut-off and normal full season irrigation were compared for four dates of harvest and two initial soil water regimes. Overall, a strong linear relationship was established between yield and ET for a wide variety of crops of the form $(Y/Ym) = 1 - 1.3\ (1 - ET/ETm)$. Accordingly, the most efficient water use during

drought periods is to supply water to match crop needs in a manner that minimizes drainage below the root zone and takes full advantage of stored soil water. Soil properties were found to be extremely important in determining soil moisture storage capacity, and climatic factors were demonstrated to be important because cool soils lead to shallower roots.
W83-03904

MOVEMENT OF WATER AND NITRATE-NITROGEN IN A TYPICAL SILT LOAM SOIL OF WESTERN KANSAS,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 5G.
W83-03908

WATER CONSERVATION BY OPTIMAL IRRIGATION SCHEDULING BASED ON CORN DYNAMIC GROWTH MODEL,
Kansas Water Resources Research Inst., Manhattan.
E. S. Lee, A. W. Biere, and E. T. Kanemasu.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256743, Price codes: A03 in paper copy, A01 in microfiche. Contribution No 236, March 1983. 34 p, 11 Fig, 9 Ref. OWRT A-107-KAN(1), 14-34-0001-2118.

Descriptors: *Corn, *Irrigation scheduling, Evapotranspiration, Crop response, *Water conservation, Model studies, Nebraska, Data collections, Kansas.

It is argued that improved irrigation scheduling techniques are important to improving water conservation and that improved irrigation scheduling is dependent upon better knowledge of a crop's response to irrigation. Reported are the results of estimating a dynamic crop response model using as extensive set of experimental data. The crop response model to be tested here has been estimated previously using data collected in Kansas. This study estimates the model using data collected in Nebraska. Thus, we have used data totally unrelated to the Kansas data used earlier. A portion of these new data were used earlier to test the model. The dynamic crop response function was estimated for three alternative formulations as a piece-wise linear function. The shape of the functions obtained are fairly consistent with each other and reasonably consistent with the function estimated earlier from Kansas data. The 'goodness of fit' of the alternative functional forms was not as good as anticipated. The estimated two segment piece-wise linear function had the best fit explaining 56% of the squared variations in yield. This study is the most extensive test to date of the dynamic crop response model we have developed.
W83-03917

DISCUSSION: OPTIMIZATION OF WATER RESOURCES FOR IRRIGATION IN EAST JORDAN, BY JANUSZ R. RYDZEWSKI AND HANI A-H. RASHID,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter.
Water Resources Bulletin, Vol 18, No 6, p 1043-1044, December, 1982. 1 Ref.

Descriptors: *Irrigation, *Water allocation, *Jordan, Water conservation, Water management.

A discussion on the above titled paper, published in Water Resources Bulletin, 17(3):367-372, June, 1981, derives a new formulation for determining the optimum level of irrigation water application. Although more variables and constraints are required, the number of linear programs is reduced from several to only one. Results of the improved formulation more correctly describe the physical system. (Cassar-FRC)
W83-03936

YIELD RESPONSE OF CORN AND SOYBEANS TO IRRIGATION AND DRAINAGE ON A CLAYPAN SOIL,
Pennsylvania State Univ., University Park. Dept. of Agricultural Engineering.
P. N. Walker, M. D. Thorne, E. C. Benham, and S. K. Sipp.
Transactions of the ASAE, Vol 25, No 6, p 1617-1621, November/December, 1982. 2 Fig, 6 Tab, 4 Ref.

Descriptors: *Crop yield, *Irrigation effects, *Drainage effects, Furrow irrigation, Sprinkler irrigation, Subsurface drainage, Surface drainage, Corn, Soybeans, Clays, Comparison studies.

Each of forty field plots having claypan soil received one of ten combinations of irrigation and drainage treatments. Each treatment was repeated twice for corn corps and twice for soybean crops. Yield data were maintained for 5 years for corn and 2 years for soybeans. The irrigation treatments were sprinkler, furrow, and no irrigation. The drainage treatments were surface, subsurface, surface plus subsurface, and no drainage. A solid set system was used for the sprinkler irrigation, and gated pipes were used for the furrow irrigation. The plots with surface drainage had a slope of 0.5%, while the others were graded level. Subsurface drainage was provided with plastic tubing on 6 meter centers. The data indicate that both irrigation and drainage result in increased corn yields on claypan soils in Illinois. Soybean crops were not as responsive as corn to irrigation and appeared to derive only a minimal benefit from drainage. Corn yields were increased by 0.8 tons per hectare by drainage alone and 2.4 tons per hectare by irrigation alone. Use of irrigation and drainage together resulted in an average increase of 4.8 tons per hectare, indicating that irrigation and drainage increase yield synergistically. The sprinkler and the furrow methods of irrigation were found to have the same effects on yield. The three types of drainage tested also appeared to have the same effects on crop yields. (Carroll-FRC)
W83-03956

DISCRETE-TIME, CUTBACK FURROW IRRIGATION,
Oregon State Univ., Corvallis. Dept. of Electrical and Computer Engineering.
S. L. Lillevik.
Transactions of the ASAE, Vol. 25, No 6, p 1646-1650, November/December, 1982. 7 fig, 9 ref.

Descriptors: *Furrow irrigation, *Automation, *Irrigation efficiency, Irrigation operation, Irrigation-return flow, Computers.

A prototype automated furrow irrigation system as been developed and tested at Utah State University. The system uses a microcomputer to control pneumatic valves and water distribution in each furrow with a gated pipe system. Rather than using several-sized control valves to achieve cutback, discrete-time cutback uses in single valve which modulates the flow rate to each furrow. Cutback furrow irrigation involves the application of water to individual furrows in two phases. In the first phase, water is applied at a constant 'wetting' flow rate, while in the second phase, this initial flow rate is reduced accofding to an experimentally determined curve of flow rate versus time. Discrete-time control eliminates of reduces problems with previous cutback systems by implementing cutback through varying the duty-cycle of the flow rate and not the rate itself. For a modulated flow rate at a fixed frequency, the duty-cycle represents the ratio of water flow to total perios. As time progresses, the duty-cycle of each furrow decreases to provide an averaged cutback. Runoff data collected from a group of test furrows and averaged to determine the cutbavk profile indicated relatively little runoff, while achieving uniform wetting of the soil of each furrow. (Carroll-FRC)
W83-03958

BORDER DITCH IRRIGATION IN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
F. T. Izuno, W. Clyma, and T. H. Podmore.
Transactions of the ASAE, Vol 25, No 6, p 1612-1616, 1621, November/December, 1982. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Border irrigation, *Irrigation ditches, *Irrigation efficiency, Irrigation operation, Irrigation practices, Agriculture, *Colorado.

Border ditch irrigation is controlled version of wild flooding which is used to many Colorado farmers to irrigate close growing crop. This method is a labor intensive form of surface irrigation which is most appropriate for crops with deep root zones and large water requirements. Use of this method requires an irrigator who has experience gained from trial and error experimentation on the particular field. Management evaluations of two fields on a Colorado farm showed application efficiencies between 25 and 45%, requirement efficiencies between 90 and 100%, and deep percolation ratios between 0.20 and 0.65. Although border ditches are approximately used on fields with cross slopes, these cross slopes make it difficult to achieve uniform irrigations. Irrigation uniformity is poor near the ditches, but improves as distance from the border ditch increases. Management variables that have the most effect on achieving an effective and uniform irrigation are location of border ditch applications, flow rates and durations, and the magnitude of the water requirement at the time of irrigation. Farmers continue to use border ditch irrigation because of tradition, their belief that the system works, a lack of knowledge of alternatives, and favorable economics. (Carroll-FRC)
W83-03959

ECONOMIC OPTIMIZATION OF IRRIGATION,
Oregon State Univ., Corvallis.
M. J. English, A. G. Nelson, B. C. Nakamura, K. C. Nielsen, and G. S. Nuss.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265140, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-80, Oregon State Univ., Corvallis, March 1983. 141 p, 5 Fig, 19 Ref, 6 Append. OWRT A-049-ORE(1), 14-34-0001-2139.

Descriptors: Irrigation, *Irrigation design, *Irrigation efficiency, Irrigation operation, Irrigation practices, *Irrigation requirements, *Irrigation scheduling, *Deficit irrigation, Irrigation performance, *Optimization, *Marginal costs, Costs, Operating costs, Economic aspects, Design criteria, Design techniques, Crop yield, Risks, Soil moisture deficiency, Evapotranspiration.

Optimization of irrigation system design, planning and operations is explored with focus on the use of deficit irrigation (deliberate underirrigation of crops) under operating circumstances. Deficit irrigation involves a radical philosophical departure from conventional practice, based on the axiom that water use should be reduced to where the marginal cost of irrigation just equals the value of the increment of yield. Implications of this axiom are explored. A case study is presented in which the marginal costs of irrigation are examined. Irrigation system design is more complex with deficit irrigation because the designer has more latitude and system performance is more difficult to predict. Design techniques for exploiting the concept of deficit irrigation are explored and an algorithm for predicting system performance outlined. Risk becomes a significant question when crops are underirrigated, partly because of difficulties in predicting yields. Irrigation scheduling is also a more important consideration under deficit irrigation. Crop variability and crop stress may be greater and more uncertain under deficit irrigation. The problem of scheduling for deficit irrigation is examined and scheduling using mathematical filtering techniques is proposed. Field research on irrigation frequency versus crop yield and evapotranspiration under low soil-moisture conditions show these to be significant considerations in irrigation optimization.
W83-04007

DEFICIT, HIGH-FREQUENCY SPRINKLER IRRIGATION OF WHEAT,
Washington State Univ., Pullman. Coll. of Agriculture Research Center.
D. E. Miller, and A. N. Hang.

Soil Science Society of America Journal, Vol 46, No 2, p 386-389, March/April, 1982. 1 Fig, 4 Tab, 20 Ref.

Descriptors: *Crop yield, *Irrigation practices, *Sprinkler irrigation, Irrigation, Water supply, Soil water, *Wheat, Evapotranspiration, Moisture availability, *Washington, Moisture deficit.

The minimum daily sprinkler irrigation rate that would not reduce wheat yields on medium- and coarse-textured soils was determined. Studies were conducted on sandy and loam soils with greatly differing water holding characteristics. Grain yields on loam soil at Prosser increased with evapotranspirate (ET) rates up to about 40 to 45 cm for the period after the line source was installed. Yields did not significantly increase with increased ET beyond this range. Soil-water samples were taken at two-week intervals during the irrigation season. Water losses from the soil plus irrigation were compared to estimated ET rates. On the sand, the yield and quality of wheat increased with increased application of water, up to about 100% estimated ET. On the loam soil, daily irrigations which equaled or exceeded 40% estimated ET produced similar yields. On this soil, the total water used, including water depleted from the soil, also varied over a wide range without affecting yields. (Baker-FRC)
W83-04032

COMMENTS ON 'A TRICKLE IRRIGATION SYSTEM FOR FREQUENT APPLICATION OF NITROGEN TO EXPERIMENTAL PLOTS', AND REPLY TO COMMENTS,
Hawaiian Sugar Planters' Association, Aiea. Crop Science Dept.
R. P. Bosshart, and L. T. Santo.
Soil Science Society of America Journal, Vol 46, No 5, p 1121-1122, September/October, 1982. 1 Ref.

Descriptors: *Irrigation programs, *Nitrogen, Fertilizer, Irrigation, Water supply, Water demand, Crop yield, *Trickle irrigation.

In their comments on the original paper (Hairston, J. E., Schepers, J. S., and Colville, W. L., Soil Science Society of America Journal, Vol 45, p 880-882, 1981) the current authors take exception to the fact that the paper was printed as a full-scale paper rather than as a technical note, citing the lack of precise data and shortcomings of the measurements taken. The paper had presented a simple system which provided good water and fertilizer distribution to small scale plots, but failed to mention the trickle tube's orifice spacing and diameter or any device for measuring the amount of water applied. No mention was made of the effect of a water applied x nitrogen interaction on yield. Water distribution efficiency was not measured; nitrogen analyses were used to evaluate fertilizer distribution, but the form of nitrogen was not stated. In their response to these comments the original authors expressed their desire to present a simple system for use on small-scale plots rather than large field scale commercial plots. The biwall trickle tube used in the study had 1 mm holes spaced 1.5 m apart on the inside tubing and 30 cm apart on the outside tubing. Orifice plugging related to microbial growth was eliminated by turning the trickle tubing upside down, keeping the orifices out of contact with the soil. The N source used was ammonium nitrate. (Baker-FRC)
W83-04033

FIELD MEASUREMENT OF DENITRIFICATION: III. RATES DURING IRRIGATION CYCLES,
California Univ., Davis. Dept. of Land, Air and Water Resources.
D. E. Rolston, A. N. Sharpley, D. W. Toy, and F. E. Broadbent.
Soil Science Society of America Journal, Vol 46, No 2, p 289-296, March/April, 1982. 9 Fig, 2 Tab, 18 Ref.

Descriptors: *Irrigation practices, *Denitrification, Nitrogen, Nitrogen oxide, Leaching, Fertilizers, Water supply, Soil water, *California.

The fluxes of nitrogen and nitrogen oxide gases were directly measured from a fertilized field soil as influenced by three different irrigation frequencies and two levels of carbon in order to understand the dynamic nature of denitrification during field wetting and drying cycles. Denitrification measured directly from nitrogen and nitrogen oxide gas fluxes from N-15 enriched fertilizer was also compared with that measured directly using the acetylene inhibition method. Small fluxes of denitrification gases were measured in this well drained alluvial soil under normal cyclic applications of irrigation water. Total denitrification ranged from .07 to 5% for the least frequently irrigated and most frequently irrigated plots, respectively. Surface denitrification gas fluxes were largest after the first irrigation, decreased to near zero values within 1 or 2 days after each irrigation, and generally decreased for subsequent irrigations. The amount of nitrogen produced was much greater than that of nitrogen oxide. The nitrous oxide flux at the soil surface varied between 5 and 27% of the total denitrification over a 40- to 50-day period. Nitrous oxide mole fractions tended to be smallest immediately after irrigation and increased as the soil water redistributed and the soil profile became less anoxic. The irrigation frequency of three irrigations per week gave higher soil nitrate content within the root zone of the crop than those of the other two frequencies. Thus, frequent, small irrigations may result in smaller leaching losses than infrequent, large irrigations. (Baker-FRC)
W83-04035

TIME AND FREQUENCY OF IRRIGATION EFFECTS ON SUNFLOWER PRODUCTION AND WATER USE,
Texas Agricultural Experiment Station, College Station.
P. W. Unger.
Soil Science Society of America Journal, Vol 46, No 5, p 1072-1076, September/October, 1982. 3 Tab, 28 Ref.

Descriptors: *Water conservation, *Irrigation programs, Plant growth, Crop yield, *Sunflowers, Irrigation, Water use, Water demand, *Texas.

The effect of irrigation at readily identifiable growth stages on sunflower growth, seed yield, seed oil percent, linoleic and oleic acid concentrations of oil, total water use, WUE (total and irrigation) was determined. The relationships between water use and seed yield, seed quality factors, and oil percent and composition were also measured. Treatments providing one or two irrigations at identifiable growth states were compared with treatments providing no, adequate, and full irrigation. Sunflowers irrigated before flowering averaged 17 cm taller than those not irrigated between emergence and flowering. Seed yields averaged highest with full irrigation, but in individual years, differences between full irrigation and other treatments were not always significant. Usually the highest seed yield resulted from flowering or late flowering irrigations. These irrigations usually also resulted in the highest seed test weight and weight/seed. Oil percent averaged highest for the emergence plus late flowering irrigation treatment and lowest with the emergence plus budding treatment. Irrigation treatments significantly affected linoleic and oleic acid concentrations of the oil, but the maximum difference among treatments was only four and five percentage units for linoleic and oleic acids, respectively. Total water use increased with increased number or irrigations, but yield increases were not proportional to water use, especially for the adequate and full irrigation treatments. With these treatments water use efficiency was less than for limited irrigation treatments that provided adequate water from flowering to later flowering. (Baker-FRC)
W83-04039

EFFECT OF DRY-SEASON SOIL MANAGEMENT OF WATER CONSERVATION FOR THE SUCCEEDING RICE CROP IN A TROPICAL SOIL,
International Rice Research Inst., Los Banos, Laguna (Philippines). Dept. of Agronomy.
S. S. Hundal, and S. K. De Datta.
Soil Science Society of America Journal, Vol 46, No 5, p 1081-1086, September/October, 1982. 7 Fig, 16 Ref.

Descriptors: *Water conservation, *Crop yield, Rice, Tropical regions, Soil management, Water management, Water demand, Soil temperature, Temperature, Mulching, Straw mulch, Tillage, Fallow tillage, *Phillipines.

Soil water conservation measures were evaluated during the fallow period of January to May in the tropical rice growing region of the Philippines. The field study was conducted on Alfisol (isothermic, clayey mixed Aquic Tropudalf) derived from volcanic materials. The field site was wet plowed and puddled, and transplanted rice was grown in the preceding wet season of 1979. At the beginning of the 1980 dry season five fallow soil management systems were established: rotovated, plowed and rotovated, herbicide treated-straw mulched, herbicide treated-bare soil, and weedy control. Highest soil temperatures were obtained in the bare soil treatment. The straw mulch application maintained the lowest temperatures. By the end of the dry season, the soil had dried to the 1 meter depth in the weedy control compared to 15 cm in soil mulch, 30 cm in straw mulch, and 45 cm in the bare soil treatment. Starting with initial soil water contents close to field capacity, a maximum water depletion of 248, 86, 55, 35, and 58 mm occurred in the weedy control, bare soil, straw mulch, plowed and rotovated, and rotovated treatments, respectively, at the end of the dry season. Groundwater tables during this period varied from about the 1.5 to 1.75 m soil depth. Rainfall requirement was significantly reduced and early crop establishment was made possible when soil was kept weed-free during the dry-season fallow. Minor differences in water conservation occurred among soil mulch, straw mulch, and bare soil systems. (Baker-FRC)
W83-04066

DESIGN FOR A FIELD SPRINKLER INFILTROMETER,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia).
S. J. Zegelin, and I. White.
Soil Science Society of American Journal, Vol 46, No 6, p 1129-1133, November/December, 1982. 7 Fig, 15 Ref.

Descriptors: *Sprinklers, *Design criteria, *Rainfall simulators, Sprinkling, Irrigation, Water supply, Field investigations, Infiltration, Rainfall-runoff relationships, Soil water.

A simple, inexpensive, and portable sprinkler infiltrometer is described which fulfills the requirement that the application of water be uniform over the sample plot and that the soil surface remain relatively undisturbed during infiltration by the size and energy of the water drops. The sprinkler infiltrometer described uses air pressure to drive water through an interchangeable nozzle onto the field plot. Application rates with uniform distribution are selected by electronically pulsing a solenoid valve between the pressurized water supply and the nozzle. A simple field experiment was performed to demonstrate the use of the sprinkler infiltrometer. Two application rates, 10 and 15 mm/hr, were tested. It was concluded that the infiltrometer provided an efficient, rapidly assembled and economical means of applying water uniformly to field plots at a selectable range of reproducible constant rates. Because the energy supply is a 12 V battery and a compressed air cylinder and because the water supply reservoir is separated from the delivery nozzle, the infiltrometer is easily and quickly transportable. (Baker-FRC)
W83-04072

EFFECT OF IRRIGATIONS SCHEDULED AT DIFFERENT STAGES OF GROWTH ON SEED PRODUCTION OF OAT,
Indian Grassland and Fodder Research Inst., Jhansi.
N. P. Shukla, S. B. Hukkeri, and M. Lal.
Indian Journal of Agricultural Sciences, Vol 52, No 12, p 837-840, 1982. 1 Tab, 4 Ref.

Descriptors: *Irrigation, *Crop yield, Oat, India, Irrigation programs, Soil properties, Moisture availability, Plant growth, Water conservation.

During the winters of 1971-72 and 1972-73 a field experiment was conducted at Jhansi, Uttar Pradesh, to study the effect of irrigations scheduled at different stages of growth on seed production of oats on loamy soil. The soil had a pH of 7.5. The quantity of moisture per meter depth of soil at field capacity was 30.8 cm and at the wilting point 8.5 cm. The pre-sowing irrigation of 5 to 6 cm water was given for seed-bed preparation in both years. The irrigations after sowing were in accordance with the treatments. The quantity of water applied at each irrigation was measured. Pooled data revealed that the seed yield of oat increased with increase in irrigation frequencies up to 3, but the yield differences due to 3 irrigations, 4 irrigations, 5 irrigations, and 6 irrigations were statistically non-significant. The increase in the yield due to 1 irrigation applied at the initiation of tillering and of 2 or more irrigations over that of no irrigation after sowing was statistically significant. There was some difference in the response to irrigation in different years. In the first year, 2 irrigations applied at late tillering and flowering gave seed yields on par with those due to 6 irrigations. Pooled data indicated that yield due to 3 irrigations applied at the initiation of tillering, jointing and milk was only on a par with that due to 6 irrigations, indicating that irrigations at these three physiological stages were adequate for satisfactory seed production. The effect of irrigation on straw yield was significant only in the first year. Higher straw production was recorded with 5 irrigations. Frequent irrigation during the vegetative phase of the crop can increase and synchronize the growth and development of tillers and thus increase the straw production. (Baker-FRC)
W83-04087

NOTE ON THE USE OF IRRIGATION WATER AND YIELD OF TRANSPLANTED RICE IN RELATION TO TIMING OF LAST IRRIGATION,
Punjab Agricultural Univ., Ludhiana (India).
B. S. Sandhu, K. L. Khera, and B. Singh.
Indian Journal of Agricultural Sciences, Vol 52, No 12, p 870-871, 1982. 1 Tab, 5 Ref.

Descriptors: *Irrigation, *Rice, *Crop yield, Irrigation practices, Water supply, Water conservation, Straw, Soil properties, Moisture availability.

A field experiment was conducted during 1976-78 with 'Jaya' rice transplanted on a puddled sandy-loam soil. The field capacity and 15-bar water storage in 180-cm soil profile were 40 cm and 14.3 cm, respectively. Bulk density of the soil in the profile varied from 1.48 to 1.55 g/cu cm. In the five irrigation treatments used the last irrigation to the crop was terminated at different times before its harvest. Compared with the conventional practice of a 7-day cut-off period, suspension of the last irrigation 14-17 days before harvest did not decrease the grain yield, but allowed a saving of 16 cm irrigation water. After cutting off the irrigation early, the crop ripened relatively more uniformly and 2-3 days earlier. Termination of irrigation 21-22 days before harvest decreased the yield insignificantly. This practice effected an additional economy of 22 cm water, which is useful where irrigation water supplies are limited. Rapid decline in grain yield beyond 21-24-day cut-off periods may be attributed partly to the corresponding significant increase in floret sterility. The number of effective tillers was not influenced by the time range of last irrigation studied. Unlike grain yield, the straw yield did decrease significantly even when the irrigation was stopped 14-17 days before harvest. Stoppage of irrigation for 14-17 days also reduced the average moisture content of fresh paddy grain from 26.2 to 20.8%; since 20% is the highest permissible limit for marketing, this cut-off period also facilitates immediate disposal of produce in the market with no need for storage. It is thus concluded that on sandy-loam and on heavier non-cracking and non-saline soils, the last irrigation to rice can be safely applied 2 weeks before its harvest. (Baker-FRC)
W83-04088

NOTE ON THE EFFECT OF SUBSOIL SODICITY ON THE WATER USE BY IRRIGATED WHEAT,
Central Soil Salinity Research Inst., Karnal (India).
C. L. Acharya, S. S. Sandhu, and I. P. Abrol.
Indian Journal of Agricultural Sciences, Vol 52, No 12, p 872-873, 1982. 1 Tab, 4 Ref.

Descriptors: *Irrigation, *Crop yield, *Wheat, Water supply, Irrigation practices, Water conservation, India, Soil properties.

An evaluation was made of the water use under different irrigation schedules for wheat grown in gypsum-treated and untreated plots of a highly sodic soil that had been under rice-wheat rotation for the past 8 years. The treated plots received gypsum in the summer of 1970 at about 15 tonnes/ha, mixed in the surface layer. Exchangeable sodium percentage at the time of the study was less than 20 up to 50 cm depth in the gypsum-treated plots, but more than 20 below 25 cm depth in the untreated plots. Wheat 'HD 2009' was seeded by drill in November 1978 in rows 30 cm apart and harvested in April. Three irrigation treatments corresponding to 5 cm of irrigation, each time after 40, 60, and 80 mm of cumulative open-pan evaporation, were imposed under both gypsum treated and non-treated plots. These were replicated four times. With a reduction in irrigation frequency, more water was contributed from the 90 cm profile for crop growth. Further, the gypsum-treated plots contributed more water from the profile than the control plots. For plots receiving irrigation after 80 mm of cumulative evaporation, the contribution of profile water from the time the crop was seeded until the time of harvest in the gypsum-treated plots was 6.8 cm, compared with 3.7 cm in the coontrol plots. However, under the high irrigation frequency there was practically no difference in the contribution of profile water in the gypsum-treated and the untreated plots. Grain yield was unaffected by irrigation frequencies, mainly because of well distributed rain occurring during the season. The grain yield was also unaffected owing to differences in subsoil sodicity. (Baker-FRC)
W83-04089

THE INFLUENCE OF WATER AVAILABILITY ON WINTER WHEAT YIELDS,
Kansas Agricultural Experiment Station, Manhattan. Evapotranspiration Lab.
R. C. Johnson, and E. T. Kanemasu.
Canadian Journal of Plant Science, Vol 62, No 4, p 831-838, 1982. 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Moisture availability, *Crop yield, *Drought, Water supply, Soil moisture, Soil water, Wheat, Kansas.

Yield and yield components of winter wheat grown under different soil water conditions were compared through field experiments. Precipitation was excluded from a 150 sq mile plot area so as to control soil water. Treatment regimes were described according to their relative preanthesis/postanthesis soil water content as high/high (H/H), high/low (H/L), low/high (L/H), and low/low (L/L). Soil water to the depth of 150 cm was monitored through use of a neutron probe. Plot yields ranged from 559 g/sq m in regime H/H to 267 g/sq in L/L and were positively correlated with head number per square meter and kernel number per head. Low preanthesis oil water reduced head number per sq m in both years. Regimes L/H and L/L had reduced kernels per spikelet compared to regimes with high preanthesis soil water. Increased kernel weight was associated with low preanthesis soil water. It is concluded that if a drought develops before grain filling in the spring,improved tiller survival and/or floret fertility could increase yields, even if some stress continued through grain filling. Under nonstress conditions, yield appears limited most seriously by the amount of assimilate required to fill a high number of kernels per sq meter. If limited amounts of water are available for spring irrigation, the maximum positive effect on yield can probably be obtained by preanthesis water application. (Baker-FRC)
W83-04102

EVALUATING LOW-VOLUME IRRIGATION SYSTEMS FOR EMISSION UNIFORMITY,
D. Handley, H. J. Vaux, Jr., and N. Pickering.
California Agriculture, Vol 37, No 1/2, p 10-12, 1983. 5 Fig, 1 Tab.

Descriptors: *Irrigation practices, *Design criteria, Irrigation engineering, Trickle irrigation.

The uniformity of discharge by low-volume irrigation systems in the field under normal operating conditions was evaluated. The evaluation was performed for 112 low volume systems on 40 ranches in the southern San Joaquin Valley. The sample included 15 different emission devices being used on nine perennial crops. The systems varied in age from 6 months to 10 years. For systems that have been in operation for one or more seasons, emission uniformities greater than 90% are regarded as excellent, between 80 and 90% as good, between 70 and 80% as fair, and below 70% as poor. About 62% of the systems evaluated were operating in the good-to-excellent range, and 38% in the fair-to-poor range. About half the problems experienced in systems demonstrating low uniformities were associated with pressure differences and half had emitter variability problems caused by factors other than pressure. In most systems the system emission uniformity was significantly lower than the test emission uniformity. Sixty percent of the pressure-related problems were attributable to poor pressure regulation. In many cases uniformity was improved by valve or regulator adjustments at manifold inlets. There was no detectable relation between the age of the system and emission uniformity. This suggests that performance over time is primarily a function of the adequacy of design and maintenance rather than physical deterioration of the system (Baker-FRC)
W83-04111

INCIDENTAL EFFECTS OF AGRICULTURAL WATER CONSERVATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
D. C. Davenport, H. J. Vaux, Jr., and R. M. Hagan.
California Agriculture, Vol 37, No 3/4, p 28-31, March/April, 1983. 1 Tab.

Descriptors: *Irrigation effects, *Agriculture, *Conservation, Benefits, Water conservation, Water quality, Economic aspects, Water rates.

The incidental effects of agricultural water conservation can be beneficial or adverse. A water conservation practice may have multiple and complex effects. For example, reduction in applied irrigation water may diminish crop yield (adverse) and decrease energy and fertilizer needs (beneficial). A table lists 23 categories (e.g., drainage disposal, fertilizers and nutrients, groundwater depth, instream needs, soil physical properties, and water quality), the water conservation actions (e.g., changes in irrigation methods or irrigation water quality, wastewater reuse, mulching, lining canals, land levelling), the incidental effects (e.g., reduction in erosion and runoff, salt buildup, decrease in groundwater recharge, decrease in stream water quality, decrease in volume of drainage water), and the on-farm and off-farm adverse or beneficial effects of each. Artificially low water prices complicate economic assessment of the external impacts of water conservation measures. Water scarcity and high water prices are the real motivating forces behind water conservation in irrigated agriculture. (Cassar-FRC)
W83-04113

EFFECT OF MULCHES ON MOISTURE AND THERMAL REGIMES OF SOIL AND YIELD OF PEARL MILLET,
Central Arid Zone Research Inst., Jodhpur (India).
J. P. Gupta.
Annals of Arid Zone, Vol 19, No 1-2, p 132-138, March-June, 1980. 1 Fig, 4 Tab, 5 Ref.

Descriptors: *Soil water, *Mulching, *Crop yield, *Water use efficiency, *Hydrothermal studies, Mulches, Semiarid lands, Arid lands, Consumptive use, Polymers, Soil temperature, Loam, Millet.

Mulches play an important role in changing the hydrothermal regime of soil and conserving soil moisture for the growth of plants in arid and semiarid regions. The effects of polyethylene and bajra husk mulches on the growth and yield of pearl millet were studied in field experiments. Soil samples were collected from different depths during crop growth, and soil moisture was determined gravimetrically on 3 m by 2 m plots mulched with 6 tons/ha of polyethylene sheet (400 gauge) or bajra husk mulch. Soil temperature was measured with Aplab telethermometers using probes, and consumptive water use was calculated from soil moisture data, taking rainfall into consideration. After harvest, crop, grain, and straw yield was recorded for each plot. Soil mean maximum temperature was lower under bajra husk mulch than under polyethylene, but a significant decrease in temperature with depth was noted under the latter. Maximum grain yield of pearl millet was obtained from soil mulched with polyethylene, followed by bajra husk, then by control plots with water use efficiencies of 10.4, 8.5, and 6.0 kilograms/mm/ha, respectively. (Geiger-FRC)
W83-04120

ANALYSIS OF THE PLANT SOIL CONTINUUM USING ELECTROPHYTOGRAMS, PHASE II,
Arizona Univ., Tucson. Dept. of Electrical Engineering.
W. Gensler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105345, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Arizona, Tucson, December 1982. 41 p, 12 Fig, 26 Ref. OWRT B-089-ARIZ(1), 14-34-0001-0205.

Descriptors: *Irrigation efficiency, Water conservation, *Water status measurement, Remote sensing, *Plant growth, *Electrochemical sensors.

The primary objective of this project is the development of a direct electrochemical sensing of plant water status in the field by means of electrochemical techniques. A further objective is the transmission of this information to the grower in a form which permits irrigation scheduling. The basic plant electropotential responses to a water stressed and unstressed condition have been determined. These responses have been converted by means of an algorithm into a numerical index of water status. An experimental telemetry system has been constructed to transfer the information to a central site for processing. This system is operational. In addition, a fourth generation telemetry system was designed and is partially completed, which incorporates all the experience gained working with the original system. This latter system is amenable to very large scale usage.
W83-04136

INCREASED WATER CONSERVATION AND PERCOLATION THROUGH IMPROVED TILLAGE PRACTICES,
Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
H. D. Wittmuss.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105584, Price codes: A03 in paper copy, A01 in microfiche. Nebraska Water Resources Center Completion Report, (1983). 28 p, 7 Fig, 8 Tab, 4 Ref. OWRT A-069-NEB(1), 14-34-0001-2129.

Descriptors: *Water conservation, Cultivation, *Deep percolation, Soil moisture, *Soil water storage, Model studies, Root zone, *Nebraska, Irrigation practices, *Tillage systems.

A technique was developed to determine soil water storage and predict deep percolation under different tillage treatments and moisture levels. The dryland farmer can use the findings to vary his tillage practices to conserve the maximum amount of moisture for increased crop production. The irrigation farmer can use the findings to vary his tillage practices to increase deep percolation from rainfall to increase groundwater storage. A model was developed to predict deep percolation below the root zone based on the ratio of actual soil moisture content of the soil in the root zone to the saturated moisture of the soil (degree of saturation) and some parametric constants depending on soil type. The amount of water stored in the root zone increased gradually during the growing season. The effect of tillage systems on soil water storage were not significant; however, orthogonal contrast showed some significant differences among treatments. There were no significant differences in deep percolation or crop yields among overall tillage treatments.
W83-04160

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

THE ESSENCE OF MATHEMATICAL MODELS OF RESERVOIR STORAGE,
National Hydrology Research Inst., Ottawa (Ontario).
V. Klemes.
Canadian Journal of Civil Engineering, Vol 9, No 4, p 624-635, December, 1982. 6 Fig, 24 Ref.

Descriptors: *Reservoir storage, *Model studies, Reservoir operation, Storage, Reservoir design, Mathematical models.

The proliferation of applied reservoir storage models has been a result of unrecognized redundancies, permitting variations of known models to be considered as new models. Causes of this situation are language barriers, specialized jargons, and limited understanding of published work. The essence of reservoir storage models is the recursive application of simplified equations of motion, the continuity and dynamic equations. A detailed analysis of four reservoir routing models and a demonstration of the fact that reservoir routing and forced regulation differ only in the choice of the second independent variable illustrate these relationships. The first independent variable is inflow, the second is the parameter(s) of the routing function for routing models and reservoir outflow or storage for forced regulation models. (Cassar-FRC)
W83-03852

INTEGRATED CONTROL OF COMBINED SEWER REGULATORS,
Montreal Urban Community (Quebec).
For primary bibliographic entry see Field 5G.
W83-03862

DRAINAGE REQUIREMENTS OF SALT AFFECTED SOILS,
Central Soil Salinity Research Inst., Karnal (India).
D. V. V. Narayana.
Annals of Arid Zone, Vol 19, No 3, p 259-263, September, 1980. 4 Tab, 5 Ref.

Descriptors: *Drainage systems, *Saline soils, *Water storage, Drainage engineering, Drainage wells, Subsurface drainage, Surface drainage, *India, Storage, tile drainage, Wells.

Saline soils in India are divided into four groups, depending on location and type of soil (alkali, organic, arid, coastal, etc.). Most are poorly drained. Surface drainage, horizontal subsurface drainage, and vertical drainage (drainage wells) have been used in various regions. Most existing surface drainage systems are underdesigned. However, the integrated three-tier system in Karnal has successfully coped with both heavy rainfall and drought conditions. It consists of collecting part of the rainfall in the cropland, directing excess rainwater to dugout ponds for storage, and draining remaining water into the regional drainage channels. Subsurface drainage, expensive to install, has not been proved necessary in this region. Vertical drains have been successful in lowering groundwater levels in areas where an aquifer with good water quality and sufficient supplies exists within 12-20 m from the surface. (Cassar-FRC)
W83-03886

OPTIMAL CONTROL OF THE CASPIAN SEA LEVEL,
M. S. Markish.
Water Resources (English Translation), Vol 9, No 2, p 122-136, March-April, 1982. 5 Fig, 4 Tab, 12 Ref. Translated from Vodnye Resursy, No 2, p 20-35, March-April, 1982.

Descriptors: *Sea level, *Statistical models, *Caspian Sea, Modeling, Mathematical studies, Evaporation, Water level, Flow control, Alternative planning, *USSR.

A refined and generalized problem of optimal control of a closed water body is presented with reference to the Caspian Sea. The approach takes into account the autocorrelation of the series of the natural annual flow to the sea and apparent evaporation from its surface, the random variability of the maximum volume of additional controlled inflow, and the possibility of cutting off certain parts of the water area of the sea to reduce total evaporation from its surface. Under the investigating conditions it was proved that the optimal control strategy when using a model with continuous time is a relay strategy with a unique switching point. An algorithm for calculating the optimal relay strategies and characteristics of the controlled regime of the sea was developed and realized on a computer. Calculation of equivalent strategies providing the prescribed stability of the level with a minimum average additional inflow is also possible. Optimal control of the Caspian level was calculated for different variants. It was shown that optimal control provides greater stability of the level with a smaller value of the average additional inflow compared to the annual delivery of constant volumes of water to the sea. Dependences of the stability of the level and use factors of the additional inflow on the maximum volume of the latter and value of the nonreturnable water consumption were obtained. These same characteristics were calculated under conditions of cutting off the shoals. The effect of other factors was also determined. The adequacy of the mathematical model used for the prototype and its completeness were substantiated by statistical tests. The method can be used for calculating the control level not only of the Caspian Sea but also of other large natural water bodies. (Baker-FRC)
W83-03949

ESTIMATING THE POTENTIAL FOR OCHRE CLOGGING BEFORE INSTALLING DRAINS,
Agricultural Research and Education Center, Lake Alfred, FL.
H. W. Ford.
Transactions of the ASAE, Vol 25, No 6, p 1597-1600, November/December, 1982. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Iron bacteria, *Iron, *Drains, *Clogging, Bacteria, Soil water, Soil porosity, Soil types, Soil bacteria, Soil solution, Chemistry of precipitation, Oxidation-reduction potential, Laboratory studies, Drainage.

Ochre, a gelatinous red to tan iron deposit in subsurface drains, can cause failure by clogging synthetic and gravel envelopes, water inlet openings, and the internal volume of drains. Ochre development depends on a source of ferrous iron Fe(II) flowing into the drains, the presence of reducing bacteria, and a source of organic carbon energy for the bacteria. Energy requirements will vary with soil type and characteristics of the iron on soil particles. Test procedures have been developed which can be used to estimate ochre potential in agricultural drains and in drains in wastewater management sites, highways, and landfills. The procedures involve estimation of the levels of Fe(II) that may occur in the soil solution (groundwater), using either soil samples incubated in the laboratory or groundwater tested directly in the field. The field portion of the procedure consists of

separating Fe(II) from the groundwater using a closed pressure filtraton through 0.45 micrometer disc filters into sulfamic acid, where the Fe(II) is stable for several days. The laboratory procedure utilizes soil from selected depths, incubated in water in culture tubes with and without a supplemental energy source, followed by filtration. Both of the methods automatically correct for soil type and pH and are useful in estimating whether the soil zone is deficient in natural energy, reducing potential by bacteria, or amorphous iron. The tests are also helpful in estimating whether Fe(II) may be flowing into area from surrounding areas or escarpments. Measurement of soil solution samples used in conjunction with the laboratory incubation of soil samples yielded the most information suitable for estimating the potential for ochre clogging. The types of soil showing the most potential for ochre formation were fine sands and silty sands, organic soils and organic pans, mixed profiles containing organic matter, gullies, flood plains, and depressions containing organic residues. (Carroll-FRC)
W83-03975

SEDIMENT AND CHANNEL-GEOMETRY INVESTIGATIONS FOR THE KANSAS RIVER BANK-STABILIZATION STUDY, KANSAS, NEBRASKA, AND COLORADO,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2J.
W83-04008

EARLY DEVELOPMENTS IN DRAINAGE ENGINEERING,
Guelph Univ. (Ontario). School of Engineering.
R. W. Irwin.
Agricultural Engineering, Vol 63, No 11, p 16-17, November, 1982. 1 Fig.

Descriptors: *Drainage engineering, *Tile drainage, *Trenches, History, Ontario, Costs, Plastic pipes.

In Ontario in 1907 most tile drains were laid by pick and shovel at the rate of 3 rods per day per person and 15 cents per rod. Horse drawn plows increased the digging rate by 50%. A wheel-type trenching machine was first produced in 1892 and was dominant until 1956. A steam-powered wood frame traction ditcher was available in Canada by 1904 and a steel frame one by 1907. These machines could dig about 100 rods per day at the cost of 7 cents per rod. Drain tiles were 2.5 and 3 inches in diameter prior to 1915 and 4 inches thereafter. Plastic drainage tubing was introduced in Ontario in 1967. In the hand digging days grade control was accomplished by water or an overhead line with gage stick. The trenching machine had a fixed sight arm. Laser grade control was introduced in Ontario in 1970. (Cassar-FRC)
W83-04135

4B. Groundwater Management

GROUND WATER PUMPING FROM SHALLOW AXISYMMETRIC PONDS,
Georgia Inst. of Tech., Atlanta. Dept. of Civil Engineering.
M. M. Aral, and T. W. Sturm.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY12, p 1469-1485, December, 1982. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Well hydraulics, *Ponds, *Pumping, Hydraulics, Shallow wells, *Georgia, Coastal plains, Unconfined aquifers, Seepage, Design criteria, Model studies, Aquifer management, Groundwater management.

An examination of the hydraulic aspects of pumping from axisymmetric ponds or large diameter wells in shallow, unconfined aquifers showed that pond storage allows groundwater pumping at higher rates during short time periods than would be possible for continuous pumping. This technique has been proposed for developing the shallow aquifers on the Georgia coastal plain to relieve overpumping of the artesian aquifer. A finite element model was developed. It considered the effects of pond storage, partial penetration, pond size, and pumping time. Application to a typical design problem showed that the total daily volume pumped increased slightly with pumping time, but both pond diameter and pumping rate became smaller as pumping time increased. The storage produced by large ponds allowed much higher pumping rates for short time periods than would be indicated by estimates of steady-state seepage rates. (Cassar-FRC)
W83-03863

FORMATION OF TRANSITION ZONE IN A BASAL AQUIFER UNDER PUMPING STRESSES,
Hawaii Univ., Honolulu. Water Resources Research Center.
S. -O. Chung, L. S. Lau, C. C. K. Liu, and H. K. Gee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265058, Price codes: A03 in paper copy, A01 in microfiche. Technical Memorandum Report No 66, August 1982. 21 p, 12 Fig, 2 Tab, 8 Ref. OWRT A-092-HI(1), 14-34-0001-2113.

Descriptors: *Aquifer characteristics, *Transition zones, *Saline water-freshwater interfaces, Experimental data, *Hawaii, Pumping, *Sand-box model.

Formation of a freshwater-sea water transition zone in a basal aquifer under pumping stresses was studied by sand-box experiments and by comparing experimental data with results from other theoretical and field investigations. Upconing height for different pumping rates and well penetration depths were measured in the laboratory. These experimental data were then compared with theoretical values computed with or without the sharp interface assumption. Dispersivity of laboratory sand was determined by matching the observed thickness of the transition zone with the theoretical value. The thickness of the transition zone was found to increase as the pumping rate and/or the partial well penetration depth increased. The results of the laboratory experiments were compatible with the values predicted by theoretical equations.
W83-03998

CLARIFYING GEOTHERMAL FLUIDS,
Envirotech Corp., Salt Lake City, UT. Eimco Process Machinery Div.
For primary bibliographic entry see Field 5F.
W83-04052

GROUNDWATER POLLUTION: A THREAT TO PUBLIC WATER SUPPLY. (GRUNDWASSERVERUNREINIGUNGEN - BEDROHUNG FUR DIE OFFENTLICHE WASSERVERSORGUNG.),
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
For primary bibliographic entry see Field 5G.
W83-04090

4C. Effects On Water Of Man's Non-Water Activities

COMPARISON OF THE SOIL WATER CYCLE IN CLEAR-CUT AND FORESTED SITES,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
R. G. Kachanoski, and E. De Jong.
Journal of Environmental Quality, Vol 11, No 3, p 545-549, 1982. 1 Fig, 5 Tab, 23 Ref.

Descriptors: *Forest management, *Subsurface drainage, *Logging, Forest watersheds, Forest hydrology, Watershed management, *Clear-cutting, Streamflow, Drainage, *Saskatchewan, Snowmelt, Surface runoff, Runoff.

The importance of subsurface flow and drainage and the effects of clear-cutting on the hydrological cycle were studied in a northern Saskatchewan forested basin October 1978 to October 1979. Surface runoff was measured with interceptor troughs and tipping bucket gages; soil water contents with a neutron probe; soil water fluxes from Darcy's law and mass balance equations; and creek flow with a water level recorder and still well. Surface runoff was negligible (0.1 cm) during the growing season on both forested and clear-cut tracts. However, during the snowmelt period surface runoff was 6.1 cm from the cut plots and zero from the forested plots. Drainage during the growing season was 9.3-13.0 cm from the cut plots and 6.4 cm from the forested plots. Stream hydrographs indicated that this basin was dominated by subsurface flow. On the average about 20% of the precipitation from major storms entered subsurface storage. The increased water yield from the clear-cut plots during snowmelt, occurring almost entirely as surface runoff, would result in higher spring peak flows and shorter lag. (Cassar-FRC)
W83-03894

RECOVERY AFTER LOGGING IN STREAMS WITH AND WITHOUT BUFFERSTRIPS IN NORTHERN CALIFORNIA,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
D. C. Erman, and D. Mahoney.
Water Resources Center Contribtion 186, University of Calif., Davis, June 1983. 39 p, 7 Fig, 11 Tab, 80 Ref, 5 Append.

Descriptors: *Forest management, *Revegetation, *Reforestation, *Clear-cutting, *Aquatic life, *Biomass, Stream biota, Lumber, Vegetation establishment, Sediment transport, Animal populations, Aquatic environment, Aquatic animals, Aquatic plants, Aquatic habitats, Stream degradation.

The impact of logging on aquatic resources involves a reduction in nearstream vegetation and disturbance of the land surface. This frequently leads to elevated sediment loads, increased water temperature, disruption of aquatic food webs, and decreased habitat diverstiy. In some cases logging has resulted in greater diversity and biomass of young salmonids. Six logged sites, six narrow-buffered sites, and 17 controlled sites were sampled from 25 streams grouped into nine blocks in northern California. The samples were taken 6-10 years after logging and 5 or 6 years after an initial postlogging study in order to evaluate recovery rates. Unbuffered streams showed considerable but incomplete recovery based on a diversity index of macroinvertebrates. Compared to the mean of control streams, the mean diversity of logged streams was 9.1% lower in 1980-81 versus 25.2% lower in 1975. Narrow-buffered streams, by contrast, changed little since the last survey. The mean diversity was 12.5% lower than controls in 1980, compared to 12.4% in 1975. The six streams showed a positive association between buffer width and diversity index. By employing a measure of transportable sediment stored in the stream bed, it was found that the logged and narrow-buffered streams still contained significantly more fine sediment than comparable control streams. Narrow buffers were not effective in promoting a more complete or rapid rate of recovery than streams without buffers. A few taxa had higher density in stations with more fine sediment, and, as a result, the diversity index was lower in those stations. (Garrison-Omniplan)
W83-03990

4D. Watershed Protection

COMPUTER AID FOR TERRACE LOCATION,
John Deere Product Engineering Center, Waterloo, IA.
K. A. Sudduth, and J. M. Gregory.
Transactions of the ASAE, Vol. 25, No. 6, p 1622-1627, November/December, 1982. 9 fig, 9 ref.

Descriptors: *Computer programs, *Erosion control, *Terracing, Contour terracing, Soil erosion, Topography, Mathematical studies.

Although farmers are exhibiting a renewed interest in terracing for erosion control, the efficient systems which farmers want often require considerable design effort. Terrace design aids using a computer which have been developed generally depend on prior placement of the terraces before calculations can be performed and require considerable time and labor for data entry. This paper reports the development of a computer program designed to locate terraces based on field topography read from a contour map. The program locates the following alternative terrace systems for a field: a conventional, or constant-grade, system with the grade specified by the user; a smoothed conventional system; and parallel terrace systems, with the terrace spacing as a multiple of machinery width. Terrace systems can be designed with multiple outlets or branched outlets. Usability of the program as a design aid is greatly enhanced by the computerized data entry system, which allows the input of data directly from the topographic map of the field. The program is generally applicable to all types of topography. In developing the program, several unique numerical techniques were developed to manipulate parametric piecewise-cubic spline functions, including algorithms to find the intersections of the functions and to smooth areas of excessive local curvature in the functions. Testing of the terrace location program with both artificial and actual data sets showed that the system worked well in most cases. (Carroll-FRC)
W83-03957

INVESTIGATIONS OF VEGETATION FOR STABILIZING ERODING STREAMBANKS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
A. J. Bowie.
Transactions of the ASAE, Vol 25, No 6, p 1601-1606, 1611, November/December, 1982. 10 Fig, 1 Tab, 10 Ref.

Descriptors: *Erosion control, *Stream banks, *Vegetation establishment, Stream erosion, Bank stabilization, Bank protection, Channel erosion, Scour, *Mississippi.

The use of combinations of vegetation, bank shaping, and structural materials to control erosion of channel banks is being tested on channels in northern Mississippi in order to develop an alternative to the exclusive use of structural materials, which is often prohibitively expensive. Factors considered in designing the combined vegetation and structural bank protection are presented, along with a detailed description of the study sites. Although a complete evaluaton will require several years, some observations made at the end of the second growing season are presented. Checking or elimination of scouring forces creating channel bed degradation is necessary before satisfactory results can be expected from the use of vegetation to stabilize or control bank erosion. the general survival and growth of the grassy and woody species of vegetation planted has been good, in spite of severe hydrologic and plant growth stresses during the period of the studies. Preliminary results indicate that native species of both the grasses and the woody species are preferable to imported varieties. The need for periodic on-site appraisal of channel conditions and for an effective maintenance program to prolong the useful life of stabilization measures and to safeguard the banks against possible erosion in the future is stressed. (Carroll-FRC)
W83-03960

SIMULATION OF SOIL EROSION FROM WINTER RUNOFF IN THE PALOUSE PRAIRIE,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W83-03973

RUNOFF AND SOIL LOSS IN TRINIDAD UNDER DIFFERENT CROPS AND SOIL MANAGEMENT,
University of the West Indies, St. Augustine (Trinidad and Tobago). Dept. of Soil Science.
F. A. Gumbs, and J. I. Lindsay.
Soil Science Society of America Journal, Vol 46, No 6, p 1264-1266, November/December, 1982. 4 Tab, 11 Ref.

Descriptors: *Runoff, *Erosion control, Rainfall-runoff relationships, Erosion, Tillage, Crops, Cowpea, Maize, Corn, *Trinidad.

The immediate objective of this study was to measure the erosion caused by different agricultural practices so that recommendations for reducing soil loss could be made. The longer term objective was to measure soil loss under different conditions and eventually to test the applicability of existing erosion equations, or to modify these for use, under Trinidad conditions. The soil on which the studies were conducted was classified as an isohyperthermic, clayey, oxidic Orthoxic Tropudult. Internal drainage was moderate to good. The soil was partly eroded. Total rainfall for each of the three periods studied was 38.8, 22.4, and 82.5 cm, respectively. At the lower levels of rainfall there was generally a significant increase in soil loss from the bare plots with an increase in slope from 11 to 22 to 52%. A nonsignificant increase in both runoff and soil loss from the cropped plots was also noted. At higher rainfall levels there were significant increases in soil loss from the bare plot and both of the cropped plots with an increase in slope from 11 to 22% only. The effect of tillage of the 22% slope on runoff and soil loss seems to have depended on the level and distribution of the rainfall and on the crop type. At low rainfall, no-tillage does not significantly affect runoff or soil loss, but it significantly reduced soil loss from bare plots if there were intense storms. At highest rainfall level, no-tillage still resulted in high soil losses, and maize and cowpea were less effective than at lower rainfall in reducing soil loss. Soil should not be exposed in the wet season, and the clean cultivation of maize and cowpea in the wet season should not be recommended for slopes greater than 11%. (Baker-FRC)
W83-04028

IMPACT OF EROSION CONTROL POLICIES ON WILDLIFE HABITAT ON PRIVATE LANDS,
Iowa State Univ., Ames. Dept. of Economics.
J. A. Miranowski, and R. L. Bender.
Journal of Soil and Water Conservation, Vol 37, No 5, p 288-291, September/October, 1982. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Soil erosion, *Erosion control, Regulations, Conservation, Water quality, Model studies, River basins, Farming, *Wildlife, Habitats, Environmental impacts, Iowa River basin, *Iowa.

Erosion control policies designed to maintain soil productivity and improve water quality tend to enhance upland wildlife habitat quality with varying degrees of effectiveness. Habitat indexing and valuation procedures are considered in conjunction with a linear programming model of the Iowa River Basin to illustrate these effects. The primary objective of the study was to measure and evaluate the effects of soil erosion control policies, through adjustments in cropping and tillage practices, on wildlife habitat quality. It was concluded that policy designed to reduce soil erosion tends to improve upland habitat quality as well as improve or protect water quality. Some policies are more effective than others in improving habitat. Policies that encourage changes in land use may have a more profound effect on habitat quality than do changes in tillage systems. (Baker-FRC)
W83-04197

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

CHLOROPHENOLS IN RIVER SEDIMENT IN THE NETHERLANDS,
Rijksinstituut voor de Volksgezondheid, Bilthoven (Netherlands). Unit for Residue Analysis.
R. C. C. Wegman, and H. H. van den Broek.
Water Research, Vol 17, No 2, p 227-230, February, 1983. 3 Fig, 2 Tab, 4 Ref.

Descriptors: *Chlorine, *Phenols, *Rivers, Bottom sediments, Gas chromatography, Pollutants, *Chlorophenols, Chemical analysis, *The Netherlands, Ketelmeer, Rhine River, *Pollutant identification.

Chlorophenols formed when wastewater containing phenolic compounds is treated by chlorination to disinfect the effluent prior to discharge into the surface water possess both odor and taste-spoiling properties. Water and sediment samples from the Rhine River and from several other surface waters throughout The Netherlands were screened for the presence of individual chlorophenols. An analytical method has been developed which used capillary gas chromatography for the determination, after derivatization, of 19 individual chlorophenols in river sediments. Using this methodology, the mimimum detectable limits are 10 micrograms per kilogram for monochlorophenols, 0.5 micrograms per kilogram for dichlorophenols, 0.2 micrograms per kilogram for trichlorophenols, and 0.1 micrograms per kilogram for tetra- and pentachlorophenols. The monitoring program showed that 2,5-dichlorophenol, 2,3,5- and 2,4,5-trichlorophenol, 2,3,4,5- and 2,3,4,6-tetrachlorophenol, and pentachlorophenol were found in all sediment samples taken from Lake Ketelmeer, which is a deposition area for Rhine River sediment. 2- and 4-Monochlorophenol and 2,3,6-trichlorophenol were never found above the detection limit. Sediment samples from the harbor and river sediment dump in the North Sea and from the Spui River contained almost no chlorophenols. The highest concentrations of chlorophenols were found in sediment samples from th Nieuwe Maas River and the Scheur River, which are located in highly industrialized areas. The chlorophenols found in the highest concentrations were 3,4- and 3,5-dichlorophenol. (Carroll-FRC)
W83-03933

EVALUATION OF CORRELATIONS BETWEEN ABSORBANCE AT 254 NM AND COD OF RIVER WATERS,
Vyzkumny Ustav Vodohospodarsky, Ostrava (Czechoslovakia).
M. Mrkva.
Water Research, Vol 17, No 2, p 231-235, February, 1983. 3 Fig, 22 Ref.

Descriptors: *Chemical oxygen demand, *Optical properties, *Pollutant identification, Rivers, Dissolved solids, Organic matter, Water quality, Water analysis, Turbidity, Measuring instruments, *Czechoslovakia.

The possibilities of continuous determinations of organic carbon and chemical oxygen demand (COD) by the permanganate or dichromate method have been investigated over a period of several years. In Czechoslovakia, an ultraviolet analyzer for absorbance measurements at 254 nanometers with automatic turbidity compensation was developed, and its performance was tested in the analysis of drinking water, surface water, and treated wastewaters in laboratories and in full-scale operation. Long-term investigations resulted in the determination of empirical conversion factors for the conversion of absorbance to COD by the permanganate and dichromate methods for various types of water. This study evaluated the correlation between the absorbance methods for various types of water. This study evaluated the correlation between the absorbance module at 254 nanometers and COD by the permanganate and dichromate methods in rivers in the lower part of the Odra River basin having varying degrees of organic pollution. A clean reach of river and two short reaches with medium and high pollution (especially contamination with lignin and humic substances and phenolic wastes below industrial waste outfalls) were evaluated. Results from studies conducted between 1973 and 1978 were evaluated statistically. Close relationships were found between absorbance and COD, and the absorbance

module at 254 nanometers is recommended for use as an indicator of organic pollution in selected reaches of the river. This method is suitable for laboratory work as well as for automatic monitoring of concentration changes in dissolved organic matter. (Carroll-FRC)
W83-03934

THE EFFECT OF VARIATIONS IN ANALYTICAL METHODS ON TRADE EFFLUENT CHARGES,
Southern Water Authority, St. Leonards (England). East Sussex Water and Drainage Div.
D. Ballinger, A. Jamison, S. Kemsley, A. Lloyd, and A. Morrish.
Water Pollution Control, Vol 81, No 5, p 665-673, 1982. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Chemical oxygen demand, *Suspended solids, *Effluent charges, Pollutant identification, Organic matter, Chemical analysis, Quality control, Industrial wastewater, Filtration, Hydrogen ion concentration.

Six variations of the modified Mogden Formula for determining COD in trade effluents were compared. pH significantly affected filtrability and settleability. The methods in which pH was adjusted to 7.0 + or - 0.05 produced up to 41% higher suspended solids results (and lower COD results) than methods not adjusting pH. The sealed tube and standard reflux methods of BOD determination were generally comparable except in wastes with substances incompletely oxidized by acid dichromate or high levels of chloride, detergents, or volatile water soluble solvents. (Cassar-FRC)
W83-03938

SOLUBLE REACTIVE PHOSPHORUS MEASUREMENTS IN LAKE WATER: EVIDENCE FOR MOLYBDATE-ENHANCED HYDROLYSIS,
S. J. Tarapchak.
Journal of Environmental Quality, Vol 12, No 1, p 105-108, January-March, 1983. 1 Fig, 1 Tab, 26 Ref.

Descriptors: *Phosphates, *Water analysis, *Molybdenum blue method, Pollutant identification, Organic compounds, Hydrolysis, Natural waters, *Lake Michigan.

The effects of Mo on phosphate estimation were investigated in filtered Lake Michigan water samples. Phosphate was measured by the Chamberlain-Shapiro extraction method after several pretreatments: acid addition, simultaneous addition of Mo and acid, or Mo addition. Phosphate values were higher for Mo addition alone. Mo addition accelerates hydrolysis in the presence of acid and either causes hydrolysis or forms organic-phosphate-Mo before samples are acidified. A major fraction of the blue color formed during analysis by the Mo blue method and its variation is apparently not the product of acid hydrolysis but may be due to reduction of organic-phosphate-Mo. (Cassar-FRC)
W83-03977

NITRATE IN NEVADA PLAYAS,
Nevada Univ. System, Reno. Desert Research Inst.
S. Leatham, L. N. Huckins, and R. L. Jacobson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265025, Price codes: A07 in paper copy, A01 in microfiche. Publication No 41086, August 1983. 128 p, 18 Fig, 11 Tab, 47 Ref, 5 Append. OWRT A-093-NEV(1), 14-34-0001-0130.

Descriptors: *Nitrates, *Nitrogen fixing bacteria, *Playas, Soil profiles, Nitrogen cycle, Nitrogen fixation, *Nevada, Great Basin Playas, *Playa sediments, Hydrogen ion concentration, Volcanic rock, Microoganisms, Cyanophyta.

Nitrate accumulations on Great Basin playas appear to depend on three factors. The factors are: 1) pH of the playa sediment; 2) amount of volcanic rocks surrounding the playa; and 3) types of microorganisms and their nitrogen-fixing capabilities. All playa samples with N0 sub 3 concentrations <1000 mg/Kg have pH values of approximately 9 or greater. Again with one exception all the samples with N0 sub 3 values >1000 mg/kg are located in basins primarily surrounded by volcanic and igneous rocks. The playas in the southern part of the Great Basin appear to have higher N0 sub 3 values perhaps due to a climate that may permit greater amounts of nitrogen fixation. Unusually high nitrate concentrations were found in soils of Yucca and Frenchman Flats. A maximum concentration of 11,100 mg/kg was found within the 2-6 inch soil depth on Frenchman playa. Maximum nitrate concentrations in the playa soils generally occurred within the 6 inch to 2 foot soil depth. The maxima for all playa sampling sites averaged 4,693 mg/kg nitrate. Soils from the bajada had lower nitrate concentrations, with an average maximum concentration of 588 mg/kg. Nitrogen fixation by blue-green algae was found to occur at 79% of the randomly chosen sample sites. Under optimum laboratory conditions nitrogen fixation ranged from 4.1 to 46,100g N sub 2/acre/day. Average nitrogen fixation in soil cores was 359g N sub 2/acre/day whereas, the average fixation by algal crusts was 5,527g N sub 2/acre/day. Where nitrate was found to accumulate there was generally an associated decrease in the pH of the soil (from about 9.0 to 7.0) possibly indicating the oxidation of atmospheric nitrogen fixed by algae to nitrate by Nitrosomonas and Nitrobacter.
W83-03994

CLOSTRIDIUM PERFRINGENS AS AN INDICATOR OF STREAM WATER QUALITY,
Hawaii Univ., Honolulu. Water Resources Research Center.
R. S. Fujioka, and L. Shizumura.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265066, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 154, June 1983. 37 p, 3 Fig, 12 Tab, 16 Ref. OWRT A-087-HI(1), 14-34-0001-1113.

Descriptors: *Bacteria, *Clostridium perfringens, Water quality, Water pollution, Streams, Effluent, Indicators, *Bioindicators, *Fecal coliform, *Fecal streptococcus, Kipapa stream, Ahuimanu stream, Oahu, *Hawaii.

The mCP medium devised by Bisson and Cabelli in 1979 was used to recover Clostridium perfringens from sewage and streams. This membrane filtration method proved to be uncomplicated and reliable. Of 98 presumptively positive colonies recovered from various stream samples, 89 or 91% were confirmed as C. perfringens by using biochemical tests, whereas only 1 of 29 (3%) of the presumptively negative colonies was subsequently confirmed as C. perfringens. The quality of streams receiving treated and chlorinated sewage effluent was determined by analyzing the effluent entering the stream as well as stream samples and below the effluent discharge site for fecal coliform (FC), fecal streptococcus (FS), and C. perfringens (CP). Chlorination was shown to drastically reduce the concentrations of FC and FS, but not CP in the sewage effluent. As a result, the concentrations of FC and FS in the chlorinated effluent were less than the natural concentrations of these bacteria in the stream, whereas the same effluent contributed significantly more CP than was naturally present in the stream. Thus, analysis of stream water for CP, but not FC or FS, clearly indicated the input of effluent into the stream. Moreover, the FC:CP ratio was useful in determining the quality and distance of a major source of pollution within a stream.
W83-03999

METAL BINDING STUDIES OF ORGANIC MATERIALS IN WATER SYSTEMS,
North Dakota Univ., Grand Forks. Dept. of Chemistry.
D. E. Bartak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265108, Price codes: A06 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State Univ., Fargo, August 1983. 101 p, 4 Tab, 21 Fig, 76 Ref. OWRT A-077-NDAK(1), 14-34-0001-2136.

Descriptors: *Speciation, *Chromatography, Infiltration, Copper, Phenols, Fulvic acids, Humic acids, Aquatic environment, Chemical reactions, *Pollutant identification, *Trace metals, Electrochemistry, Metal complexes, Water sampling.

The chemical speciation of trace metals in aquatic environments play a key role in their transport, chemical reactions, and biological availability. The nature and concentration of a given trace metal in solution is most important in determining its speciation. This research developed a technique for the quantitation of metal complexes in natural water samples. Using modified size-exclusion chromatography and reversed-phase ion-pair chromatography, metal complexes were separated and detected using an electrochemical flow-cell detector. A reverse pulse amperometry mode is used to minimize oxygen interferences in the flow system. Optimum conditions for the chromatographic columns, which utilized a copper(II) eluant at pH=7.4, including gel particle size, eluate flow rate and concentration of applied sample were determined using a series of polyaminocarboxylic acids. The equilibrium M+L ML is established quickly and is maintained by constant metal ion concentration made to the eluent. This prevents the dissociation of labile complexes. Polyaminocarboxylic acids used in developing the technique were DTPA, EDTA. and NTA. Size-exclusion chromatograms of a series of amino acids, carboxylic acids and phenols were studied in developing the technique. Polyaminocarboxylic acids and natural water ligands were tested on the reversed-phase ion-pair column in preliminary studies to establish its utility for the separation of metal complexes. Detection limits for EDTA which had been separated on all three chromatographic systems were calculated.
W83-04003

ASSESSMENT OF HYDROLOGIC CONDITIONS IN POTENTIAL COAL-LEASE TRACTS IN THE WARRIOR COAL FIELD, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 2A.
W83-04010

A STATISTICAL ANALYSIS OF THE QUALITY OF SURFACE WATER IN NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W83-04014

DIRECT DETERMINATION OF ALUMINIUM IN NATURAL WATERS BY LASER STEPWISE PHOTOIONIZATION,
Akademiya Nauk SSSR, Moscow. Inst. Spektroskopii.
G. I. Bekov, A. S. Yegorov, V. S. Letokhov, and V. N. Radayev.
Nature (London), Vol 301, No 5899, p 410-412, February 3, 1983. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Water analysis, *Aluminum, *Measuring instruments, Lasers, Photoinionization, *Photoionization, Chemical analysis, *Pollutant identification.

A new highly sensitive analytical method for the analysis of microelements and aluminum, particularly in natural waters, is presented which is based on a technique involving thermal atomization of the sample under vacuum and detection of the element atoms through their stepwise excitation to a Rydberg state and subsequent ionization by electric field pulse. Aluminum was determined in natural waters as follows. A water sample was introduced into a tantalum crucible and evaporated at 90 degrees C to obtain a dry residue. The crucible and its contents were placed in a vacuum chamber. The evaporating atoms and molecules of the sample were formed into an atomic-molecular beam using diaphragms. The beam was irradiated between two electrodes by two tunable dye lasers pumped simultaneously with a nitrogen laser. The wavelengths of the dye lasers were tuned for two step excitation of aluminum atoms to a Rydberg state. After laser excitation an electric pulse that

ionized all the Rydberg atoms was fed to the electrodes. The resulting ions were pushed by the same electric field pulse through a hole in one of the electrodes, then they were detected by an electron multiplier. The ion signal from the electron multiplier was passed to a boxcar averager and was registered by a recorder. This method has been used to measure dissolved aluminum in samples taken in the mouth of the Kura River at the Caspian Sea (Baker-FRC)
W83-04016

A PROPOSED ROUTINE METHOD FOR DETERMINING POLYCYCLIC AROMATIC HYDROCARBONS (VORSCHLAG FUR EINE ROUTINEMETHODE ZUR BESTIMMUNG POLYCYCLISCHER AROMATISCHER KOHLENWASSERSTOFFE),
Technische Univ., Dresden (German D.R.). Bereich Hydrobiologie.
B. Wiemer.
Acta Hydrochimica et Hydrobiologica, Vol 9, No 3, p 337-345, March, 1981. 5 Tab, 50 Ref. (No English Summary).

Descriptors: *Water analysis, *Hydrocarbons, *Thin layer chromatography, *Pollutant identification, *Chemical analysis, Water sampling, Costs, Polycyclic aromatic hydrocarbons, Ultraviolet radiation, Chromatography, Separation techniques, Isolation, Sediments.

It is important to find a reliable and reproducible method for detecting polycyclic aromatic hydrocarbons (PAH) in water because they occur in very low concentrations, together with other organic and inorganic substances. An overview of previously published procedures for the concentration, isolation or separation, and identification of PAH is presented in tabular form. Since costs for gas and liquid chromatography are high and these methods of isolation and identification are not comprehensive, thin-layer chromatography, a relatively simple and inexpensive procedure, is the method of choice. Detailed instructions for the procedure are given, including type of chemicals required and their manufacturers and equipment, for sample taking, chromatography, distillation, and cyclohexane purification. Concentration of a 1,000-ml water sample is done with 60 ml double-distilled cyclohexane, evaporated off to 0.1 ml. The sample is then prepurified on the thin-layer plate with double development of the plate using ultraviolet light and a 1:1 mixture of benzene and cyclohexane for elution. The 0.25-mm layer is composed of silica gel G, acetylated cellulose, and aluminum oxide G. After two-dimensional development and drying of the layer, the slide is placed under an ultraviolet light (366 nm) and sample spots compared with a standard solution for position and size. Spot areas are transferred diagramatically to paper and are measured planimetrically. Variance analysis showed that this method is suitable for semiquantitive determination of 3,4-benzpyrene, 11,12-benzofluoranthene, indeno-1, 2,3-(cd)pyrene, fluoranthene, and 1,12-benzoperylene. Testing of the concentration procedure revealed that 71.5-120% of the added amount of PAH was recovered. For PAH detection in sediments, only the concentration procedure need be adapted. (Gish-FRC)
W83-04047

THE USE OF GLASS-FIBER PAPER IN WATER ANALYSES. PART 1: PROPERTIES, PREPARATION, RINSING AND SCOURING LOSSES (VERWENDUNG VON GLASFASERPAPIER IN DER WASSER-ANALYTIK. TEIL 1: EIGENSCHAFTEN, VORBEREITUNG, ABSPUL- UND AUSWASCHVERLUSTE).
Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.). Aussenstelle Labor Rudolstadt-Schwarza.
P. Loth.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 5, p 495-498, May 1980. 2 Tab, 8 Ref. (No English Summary).

Descriptors: *Sample preparation, *Water analysis, *Filters, *Scour, *Performance evaluation, Laboratory equipment, Fiberglass paper filters, Weight, Physical properties, Wash water, Paper filters, Filtration, Detection limits, Seston.

Two types of fiberglass paper were tested for use as filters in water analysis. Type 13-100 weighed 100 g/sq m, was 0.8 mm thick, and had a separation capacity of 99.90%, air resistance of 12 mm H20, a breaking load of 0.75 kg/15 mm, a temperature tolerance of 180C, and atmospheric water absorption of 0.75%. Corresponding figures for type 15-90 were 90 g/sq m, 0.8 mm, 99.95%, 10 mm H20, 0.50 kg/15 mm, 240C, and 0.50%. Two preparation procedures were tested: the simple procedure (s) consisted of centrifugation in distilled water (about 1 min), suction of 200 ml distilled water through the paper, and drying of the filter at 105C, followed by weighing; the full procedure (f) consisted of drying the filter at 105C for 60 min, followed by s. The f procedure resulted in a smaller rinsing and scouring loss for filters with a diameter of 40 mm (3.43 vs 3.94 mg/filter for 15-90, 2.42 vs 3.31 mg/filter for 13-100) because preliminary drying resulted in a loss of mass. Another factor to be considered when choosing which paper to use is the detection threshold, which was calculated as 1.3 mg/l for 15/90 for both procedures and 1.5 and 1.1 mg/l for 13-100 for procedures s and f, respectively. While 13-100 (f) is best, 15-90 (f) could also be used satisfactorily. For practical application (e.g., seston determination), the scouring effect need only be taken into account in water with a low seston content; as long as the seston concentration reaches only 1.3 mg/l, scouring loss remains within the acceptable error range of 20%. The advantages of fiberglass paper are ease of application, adequate weight constancy, and good filtration performance. It is quicker and less expensive to use than membrane filters. (Gish-FRC)
W83-04050

USE OF THE MUSSEL MYTILUS-EDULIS-PLANULATUS (LAMARCK) IN MONITORING HEAVY METAL LEVELS IN SEAWATER,
Tasmania Univ., Hobart (Australia). Dept. of Zoology.
D. A. Ritz, R. Swain, and N. G. Elliott.
Australian Journal of Marine and Freshwater Research, Vol 33, No 3, p 491-506, 1982. 9 Fig, 3 Tab, 25 Ref.

Descriptors: *Heavy metals, *Seawater, *Monitoring, *Bioassays, *Mytilus, Water pollution effects, Cadmium, Copper, Lead, Zinc, Accumulation, Animal tissues, Mussels, Absorption, Bioindicators, *Australia, Tasmania, Pollutant identification.

The accumulation of cadmium (Cd), copper (Cu), lead (Pb) and zinc (Zn) in tissues of the mussel, Mytilus edulis planulatus, was examined in seawater spiked with different metal concentrations. A linear relationship was found for all the metals tested, and, for some metals, even after exposure to the metal for up to 86 days. The relationship between a metal's concentration in seawater and its rate of accumulation in M. e. planulatus over a 40-day period was determined. Field test results showed that the rated of accumulation could be used as a sensitive method for estimating metal concentrations in seawater with less trouble than techniques involving direct analysis. A monitoring program is proposed in which M. e. planulatus may be used to quantify concentrations of heavy metals in seawater. Some biological and physicochemical parameters which may affect the accumulation of heavy metals in M. e. planulatus and limit the usefulness of this mussel as a bioassay organism in monitoring programs are considered. (Geiger-FRC)
W83-04053

CHEMICAL EVOLUTION OF ORGANIC MICROPOLLUTION DURING OZONATION OF FILTERED WATER (EVOLUTION CHIMIQUE DES MATIERES ORGANIQUES AU COURS DE L'OZONATION D'UNE EAU DE SURFACE FILTREE),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5F.
W83-04058

USE OF PARTICLE SIZE ANALYSIS IN DRINKING WATER PREPARATION (ZUM EINSATZ VON PARTIKELGROSSENANALYSEN IN DER TRINKWASSERAUFBEREITUNG),
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
M. R. Jekel.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 11, p 555-560, 1982. 8 Fig, 3 Tab, 14 Ref.

Descriptors: *Water analysis, *Suspended solids, *Particulates, Filtration, Ozonation, Sedimentation, Flocculation.

More detailed information can be gathered through the use of particle concentration and size analysis of waters as a direct method than scattered light measurements or gravimetric determination of suspended matter. A mechanism is described by which measurement of the projection area of suspended particles above one micron can be determined. Data from three treatment plants with different concepts shows the efficiency of rapid filtration, ozone-floc filtration and the combination of preozonation, flocculation with sedimentation and rapid filtration in view of particle numbers, size distributions and volume concentration of solids. A comparison of scattered light measurements in different angles with particle analysis showed a better correlation of the analysis data with the forward scattering light. (Baker-FRC)
W83-04091

IDENTIFICATION AND MUTAGENIC PROPERTIES OF SOME CHLORINATED ALIPHATIC COMPOUNDS IN THE SPENT LIQUOR FROM KRAFT PULP CHLORINATION,
Svenska Traeforskningsinstitutet, Stockholm.
K. P. Kringstad, P. O. Ljungquist, F. de Sousa, and L. M. Stromberg.
Environmental Science and Technology, Vol 15, No 5, p 562-566, May, 1981. 4 Tab, 33 Ref.

Descriptors: *Organic compounds, *Chlorination, *Mutagens, Pulp wastes, Kraft mills, Pollutant identification, Mutagenesis, Toxicity, Gas chromatography, Carcinogens.

Some chlorinated compounds found in spent liquor from bleaching softwood kraft pulp were identified by gas chromatography/mass spectrometry after enrichment by sorption (XAD 4) and ion exchange (DEAE Sepharose). Compounds included chloroform and carbon tetrachloride, both known carcinogens, and 1,3-dichloroacetone and 2-chloropropenal, strong mutagens. Other compounds in the spent liquor were dichloromethane, bromodichloromethane, dibromochloromethane, trichloroethylene, tetrachloroethylene, pentachloropropene, monochlorinated methylbutenes, monobrominated methylbutene, tetrachloroallene, methyl dichloroacetate, ethyl chloroacetate, ethyl dichloroacetate, ethyl trichloroacetate, monochloroacetone, 1,1-dichloroacetone, 1,1,1- and 1,1,3-trichloroacetone, 1,1,1,3- and 1,1,3,3-tetrachloroacetone, penta and hexachloroacetone, trichlorocyclobutenone, cyclopentene-1,1-diones, and monochloro- and trichloroacetaldehyde. (Cassar-FRC)
W83-04094

THE DETERMINATION OF TRACE ELEMENTS IN NATURAL WATERS USING THE STABILIZED TEMPERATURE PLATFORM FURNACE,
Perkin-Elmer Corp., Norwalk, CT.
D. C. Manning, and W. Slavin.
Applied Spectroscopy, Vol 37, No 1, p 1-11, 1983. 16 Fig, 6 Tab, 47 Ref.

Descriptors: *Water analysis, *Trace metals, Aluminum, Beryllium, Arsenic, Cadmium, Cobalt, Chromium, Copper, Manganese, Nickel, Lead, Selenium, Vanadium, Atomic absorption spectroscopy, Spectroscopy.

Methods are presented for the determination of several trace elements in natural waters and effluents. The elements studied included Al, As, Be, C, Co, Cr, Cu, Mn, Ni, Pb, Se, and V. The stabilized temperature platform furnace was used

with suitable matrix modifiers. Confirmation of the technique was secured by recovery experiments at four different concentration levels. Only simple aqueous standards were required, and the method of additions was not used. A simple recovery experiment gave satisfactory confirmation of freedom from chemical interference. The detection limits in natural waters were less than 1 microgram/liter, closer to 0.1 microgram/liter for most of the elements. Precision was 10-15%. Clean-room facilities are not required for this method. (Baker-FRC)
W83-04118

A RESONANCE RAMAN METHOD FOR THE RAPID DETECTION AND IDENTIFICATION OF ALGAE IN WATER,
Rhode Island Univ., Kingston. Dept. of Chemistry.
S. K. Brahma, P. E. Hargraves, W. F. Howard, Jr., and W. H. Nelson.
Applied Spectroscopy, Vol 37, No 1, p 55-58, 1983. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Water analysis, *Algae, *Remote sensing, *Spectroscopy, Raman spectroscopy, Light scattering, Water quality.

Because of the high sensitivity of the resonance Raman method for detecting carotenoids and chlorophylls, most algae should exhibit strong spectra in vitro, despite the pigments accounting for only a small fraction of the cellular biomass. Attempts were made to determine the reproducibility of spectra of several species in vitro; whether spectra are sufficiently unique for identification at different taxonomic levels; the variability of spectra at different growth stages; and the rapidity of data collection. Spectra taken at 488 or 457.9 nm are of high quality and are sufficiently distinct to differentiate clones at the algal class level, and possibly also at the genus level. Strongest peaks occur near 1527 and 1158/cm. However, information is contained in the entire region between 900 and 3000/cm due to associated overtone and combination bands which can be assigned along with fundamental vibrations. Chlorophyll peaks are also quite pronounced. Spectra obtained using rapid flow techniques match those taken using slurries in sealed tubes if low laser power is used. The sensitivity and rapidity of the techniques suggest that it may be useful in remote sensing applications. (Baker-FRC)
W83-04119

DIRECT DETERMINATION OF TRACE AND SUBTRACE METALS IN NATURAL WATERS BY DPASV. THE USE OF LONG-LASTING SESSILE-DROP MERCURY ELECTRODES COMPARED TO COMMERCIAL HANGING-DROP MERCURY ELECTRODES (KEMULA TYPE),
Rome Univ. (Italy). Ist. de Chimica.
R. Andruzzi, A. Trazza, and G. Marrosu.
Analytical Letters, Vol 15, No 19, p 1565-1584, 1982. 7 Fig, 1 Tab, 9 Ref.

Descriptors: *Trace metals, *Electrodes, *Metals, Pollutant identification, Cadmium, Water analysis, Voltammetry, Mercury electrodes.

The performance of a new semi-stationary mercury electrode was compared with two commercially available Kemula hanging mercury drop electrodes (HMDE) for direct determination of trace and subtrace levels of metals in water and seawater using differential pulse anodic stripping voltammetry. The long-lasting sessile-drop mercury electrode (LLSDME) produced relative standard deviations of 1.3-5.3% in an analysis of Cd (19.3-57.7 ng per liter) added to a sodium chloride solution. Standard deviations for a metrohm HMDE electrode were 6.0-12.2%. In addition the Cd peak of the LLSDME was more defined. The LLSDME was also much more sensitive to Cd in seawater than a silicone-coated HMDE, which must be used in the presence of natural surface active substances. The silicone-coated HMDE was not suitable for determination of Cd concentrations below 40 ng per liter. (Cassar-FRC)
W83-04122

DETERMINATION OF MERCURY IN WATER BY FURNACE ATOMIC ABSORPTION SPECTROMETRY AFTER REDUCTION AND AERATION,
Exxon Nuclear Idaho Co., Inc., Idaho Falls.
D. D. Siemer, and L. Hageman.
Analytical Chemistry, Vol 52, No 1, p 105-108, January, 1980. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Water analysis, *Mercury, Heavy metals, Chemical analysis, Spectral analysis, Sample preparation.

In order to combine the excellent absolute sensitivity of graphite furnace atomic absorption with the large sample volume capability of the Hatch and Ott process for mercury determination in aqueous solutions at low concentrations, the gold-plated, porous graphite atomizer tube mercury filtration system previously applied to air and solids analysis was adapted to water analysis. The technique should also free the overall analytical response from any sensitivity to variations in experimental conditions which affect only the rate at which a given mass of mercury is sparged from the sample solution. Mercury present in the water samples was reduced to the metal in a bubbler and sparged from the solution with a stream of air. The gas stream was then filtered through porous, gold-plated graphite furnace atomizer tubes which retained the mercury. The tubes were then placed into either a carbon rod atomizer or a Woodriff furnace for the actual atomic absorption mercury determination. Each determination takes about 3 minutes. The detection limit was about 10 ppt. The main disadvantages are that there are additional manipulations required to perform an analysis and the fact that the analyst will have to make his own tubes and filter adaptor as they are not commercially available. (Baker-FRC)
W83-04123

AN EVALUATION OF AUTOMATED SPECTRUM MATCHING FOR SURVEY IDENTIFICATION OF WASTEWATER COMPONENTS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY,
Environmental Research Lab., Athens, GA.
W. M. Shackelford, D. M. Cline, L. Faas, and G. Kurth.
Analytica Chimica Acta, Vol 146, p 15-27, 1982. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Pollutant identification, *Wastewater treatment, Chemical analysis, Gas chromatography, Mass spectrometry, Data collections.

An automated system for extracting spectra and matching them against a library of reference spectra was assembled and tested on 20,000 g.c.m.s. data files over a period of 2.5 years. Data used in the study had been collected from a comprehensive study of wastewater from industrial and publicly owned treatment works. The use of an automated spectrum matching system for survey identification proved quite feasible with little intervention. The reliability of matching when an historical library of retention data is used in conjunction with the spectrum library is at least 65%, including matching specific isomers. In this study a 71% overall reliability was achieved when specific isomer resolution was not required. Use of retention data greatly enhances the reliability of lower quality matches, but has little effect on high quality matches. Both positive and negative points of the match must be considered before reliability is assigned. (Baker-FRC)
W83-04124

SINGLE-DROP TENSAMMETRY,
Aarhus Univ. (Denmark). Dept. of Chemistry.
D. Britz.
Analytica Chimica Acta, Vol 115, p 327-330, March, 1980. 4 Fig, 8 Ref.

Descriptors: *Surfactants, *Water analysis, Chemical analysis, Solutions, Tensammetry.

The use of a single-drop sweep technique and a minicomputer or microprocessor is proposed for the determination of surfactant species in solution via tensammetry. In tensammetry the peak height is the usual analytical signal employed. However, a better analytical signal to use in surfactant analysis is the peak potential, which is logarithmically related to concentration over a wide range and will not suffer from iR drop problems. For large surfactant concentrations this peak potential is the recommended analytical signal to be used, but at low concentrations the peak height may be better. Single drop experiments were conducted using an alpha LSI 16-bit minicomputer with 4K of volatile core coupled with a laboratory-built potentiostat. The results achieved demonstrate the utility of single-drop, differential staircase sweep tensammetry. (Baker-FRC)
W83-04125

POTENTIOMETRIC STRIPPING ANALYSIS FOR MERCURY AFTER PRECONCENTRATION IN A POTASSIUM PERMANGANATE TRAP,
Goeteborg Univ. (Sweden). Dept. of Analytical and Marine Chemistry.
D. Jagner, and K. Aren.
Analytica Chimica Acta, Vol 117, p 165-169, June, 1980. 1 Fig, 3 Ref.

Descriptors: *Mercury, *Water analysis, Chemical analysis, Heavy metals, Potentiometry, Chemical interferences.

An acetate buffer containing potassium permanganate and copper(II) was used as a trap solution for mercury prior to potentiometric stripping analysis. A potentiometric stripping curve is presented which was recorded after 16 min of pre-electrolysis in 5 ml of trap solution into which the total mercury content of a 1500-ml water sample had been preconcentrated. The mercury concentration of the water sample was 0.19 micrograms/liter. A calibration plot was obtained by spiking 1500 ml samples of mercury-free double distilled water samples with known amounts of mercury(II). Prior to potentiometric stripping analysis the mercury content of the water sample was pre-constructed into a 5 ml trap solution. The relative accuracy of the method is on the order of 10-5% in the concentration range investigated, 0.02-5 micrograms/liter. Sample contamination and impure reagents were the major factors limiting the accuracy. The detection limit in potentiometric stripping analysis is inversely proportional to the time of pre-electrolysis. The maximum practical pre-electrolysis time is about one hour, which corresponds to a mercury detection limit of 2 micrograms/liter in the trap solution. Since the maximum sample volume is 5 liters, this corresponds to a detection limit in the sample of 0.002 micrograms per liter. This technique can be used as an alternative to atomic absorption spectrometry. Simpler instrumentation is required for potentiometric stripping, and the mercury signal is easily identified by its stripping potential, so that analyses can be done semi-automatically. (Baker-FRC)
W83-04126

DETERMINATION OF TRACE AMOUNTS OF MOLYBDENUM IN NATURAL WATERS BY SOLVENT EXTRACTION-ATOMIC-ABSORPTION SPECTROMETRY, AFTER CHELATING ION-EXCHANGE PRECONCENTRATION,
Seville Univ. (Spain). Dept. of Basic and Applied Chemistry.
M. Ternero, and I. Gracia.
Analyst, Vol 108, No 1284, p 310-315, 1983. 1 Fig, 4 Tab, 28 Ref.

Descriptors: *Molybdenum, *Water analysis, *Chelation, Pollutant identification, Trace metals.

A proposed method for determination of molybdenum in natural waters involves preconcentration on a Chelex-100 chelating resin and elution with ammonia solution, followed by extraction with a complexing reagent, 1,4-dihydroxyphthalimide dithiosemicarbazone dissolved in N,N-dimethylformamide/isoamyl alcohol (1:4), with final determination by atomic absorption spectrometry. Adding ascorbic acid solution before extraction eliminated the interferences from vanadium and ferric iron.

Other interfering metallic ions were not retained well on the chelating resin. The sensitivity of the method was 0.3 micrograms per liter for 1% absorption. Mo levels (micrograms per liter) in several natural waters in Spain were 0.3 in bottled water, 0.9 in a public water supply (Seville), 2.7 in Guadalquivir River water, 6.3 in the dock area of the river, 7.5 in Atlantic Ocean water, and 9.9 in estuary water (Huelva). (Cassar-FRC)
W83-04127

SPECTROPHOTOMETRIC DETERMINATION OF PHOSPHATE IN RIVER WATERS WITH MOLYBDATE AND MALACHITE GREEN,
Okayama Univ. (Japan). Dept. of Chemistry.
S. Motomizu, T. Wakimoto, and K. Toei.
Analyst, Vol 108, No 1284, p 361-367, 1983. 6 Fig, 5 Tab, 13 Ref.

Descriptors: *Phosphates, *Water analysis, Pollutant identification, Ammonium molybdate, Malachite green, Spectrophotometry, Trace elements.

Trace amounts (ppb) of phosphate were determined in river water by spectrophotometric measurement at 650 nm of the color formed by ammonium molybdate and malachite green solutions added to the sample after acidification with sulfuric acid and 40 min heating at 90C in a water bath. Polyvinyl alcohol stabilized the color for at least 1 day. The relative standard deviation was <4%; the recovery, 95-101%. Phosphorus concentrations (ppb) in water from three Japanese rivers were: Asahi, 10.6-37.5; Yoshii, 21.9-33.0; and Takahaski, 13.2-30.8. (Cassar-FRC)
W83-04128

SPECTROPHOTOMETRIC AND FLUORIMETRIC DETERMINATION OF BORON IN SOILS, PLANTS AND WATER BY EXTRACTION WITH 2-METHYLPENTANE-2,4-DIOL IN ISOBUTYL METHYL KETONE,
Zaragoza Univ. (Spain). Dept. of Analytical Chemistry.
J. Aznarez, A. Bonilla, and J. C. Vidal.
Analyst, Vol 108, No 1284, p 368-373, 1983. 2 Fig, 4 Tab, 20 Ref.

Descriptors: *Boron, *Water analysis, Pollutant identification, Spectrophotometry, Fluorometry.

Two methods for determination of boron were developed. Both began with extraction of boron with 2-methylpentane-2,4-diol in isobutyl methyl ketone (to eliminate iron interference). For the spectrophotometric procedure (reading at 510 nm) the color was developed by adding curcumin solution in glacial acetic acid. For the fluorimetric procedure (reading at 390 or 400 nm) the color was developed by reaction of boron with dibenzoylmethane-isobutyl methyl keton solution and concentrated phosphoric acid. Boron concentrations in soil samples were 78-288 micrograms per g; in plant samples, 15.5-60.1 micrograms per g; and in natural waters from the province of Teruel, Spain, 124-255 micrograms per liter. The spectrophotometric and fluorimetric methods applied to the same samples produced comparable results. (Cassar-FRC)
W83-04129

ANALYSIS OF CHEMISTRY ASSOCIATED WITH OZONOLYSIS OF ORGANIC POLLUTANT MOLECULES IN WATER,
Wesleyan Univ., Middletown, CT.
W. C. Pringle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105394, Price codes: A05 in paper copy, A01 in microfiche. Institute of Water Resources Completion Report, Univ. of Connecticut, Storrs, September 1983. 77 p, 18 Fig, 2 Tab, 30 Ref, 1 Append. OWRT B-017-CONN(2), 14-34-0001-1213.

Descriptors: *Pollutant identification, *Chlorinated hydrocarbons, Ozonation, Spectroscopy, Water analysis, Analytical techniques, Water Chemistry, Fluorescence.

Ozonation of dibenzofuran and several chlorinated hydrocarbons in aqueous solutions and non-participating solvents is reported. The rate constants, activation energy, products and possible reaction mechanisms are determined. The ozonation is three orders of magnitude faster in water than nonaqueous solutions. Spectroscopic techniques for detection of trace pollutants in water are reported. A linear array Reticon detector system capable of detecting weak, energy-resolved fluorescence at high resolution has been built, modified and tested. It has been shown that addition of an image intensifier would result in a detector several orders of magnitude more sensitive than a photomultiplier tube.
W83-04141

DETERMINING RESIDUAL CHLORINE: EFFECT OF TEMPERATURE ON THE TITRAMETRIC STARCH-IODINE END POINT,
Ametek, Inc., Sheboygan, WI. Plymouth Products Div.
G. L. Hatch, and V. Yang.
Journal of the American Water Works Association, Vol 75, No 3, p 154-156, March, 1983. 3 Fig, 24 Ref.

Descriptors: *Temperature effects, Chlorination, *Residue chlorine, *Iodometric titration, *Pollutant identification, *Chlorine, *Volumetric analysis.

The determination of low levels of residual chlorine by the starch-iodine titrimetric method is influenced by temperature. For chlorine concentrations of 0.25-3.0 mg per liter premature starch-iodine end points cause underestimation of 0.25 mg per liter at 30C and 0.70-0.75 mg per liter at 40C. All titrations should be conducted at temperatures below 20C. If analyses in water treatment plants are conducted at warmer temperatures, overchlorination, with greater costs and increased trihalomethane formation, could result. (Cassar-FRC)
W83-04176

DETERMINATION OF TRACES OF COPPER IN TAP WATER, IRON AND STEELS BY ELECTROTHERMAL ZEEMAN ATOMIC ABSORPTION SPECTROMETRY WITH A GRAPHITE CUPPED FURNACE,
Kitami Inst. of Tech., Hokkaido (Japan).
I. Atsuya, K. Ito, and M. Otomo.
Analytica Chimica Acta, Vol 147, p 185-192, 1983. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Copper, Potable water, *Iron, *Steel, *Pollutant identification, *Spectrophotometry, Drinking water, Water analysis, Separation techniques, Trace elements.

The determinations of copper in iron, steels and tap water by electrothermal Zeeman atomic absorption spectrometry with a graphite cupped furnace are described. The procedures are optimized with respect to drying, ashing temperatures, and hydrochloric acid concentration, thus allowing copper to be determined in steel and iron samples without preliminary separation. Use of a graphite cupped type furnace reduces interfering effects originating from small variations in atomization rate. The effects of iron and other elements present in iron and steel on the determination of copper were also examined. Traces of copper in tap water were determined after preconcentration by coprecipitation with lead sulfide, with blank corrections for the acids and water samples used. The present technique provides a simple rapid, sensitive and accurate method of analysis, requiring no preseparation and only a small sample size. (Geiger-FRC)
W83-04189

DETERMINATION OF DEUTERIUM OXIDE IN WATER BY REVERSED-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Toyohashi Univ. of Technology (Japan). School of Materials Science.
K. Jinno.
Analytica Chimica Acta, Vol 147, p 393-395, 1983. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Deuterium, *Pollutant identification, High performance liquid chromatography, Water analysis, Heavy water, *Chromatography, Hydrogen.

The determination of deuterium oxide in admixture with water by reversed-phase high-performance liquid chromatography (HPLC) is described. A Trirotar III connected with an SE-11 refractive index detector served as liquid chromatography, and the stainless steel tube column was packed with Jasco Finesil C18. A heavy test water served as sample, and acetonitrile and double-distilled water were used as mobile phase. Detection limits were < 0.1% deuterium oxide in a sample size of only a few microliters. The whole analysis may be performed in less than 4 minutes. (Geiger-FRC)
W83-04190

POTENTIOMETRIC STRIPPING WITH MATRIX EXCHANGE TECHNIQUES IN FLOW INJECTION ANALYSIS OF HEAVY METALS IN GROUND-WATER,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.
A. Hu, R. E. Dessy, and A. Graneli.
Analytical Chemistry, Vol 55, No 2, p 320-328, 1983. 14 Fig, 1 Tab, 21 Ref.

Descriptors: *Water analysis, *Groundwater, Metals, *Heavy metals, Copper, Lead, Cadmium, Bismuth, Tin, Water quality, Groundwater contamination, Potentiometry, *Pollutant identification.

The application of flow injection analysis techniques to the electrochemical determination of metals in water samples by means of an automated, computerized system is considered. The advantages of flow injection analysis (FIA) as a transport system and potentiometric stripping analysis (PSA) as an analytical technique are combined to enhance sample throughput and selectivity for trace metal determination in natural water. The theory behind the method is developed, and the hardware, software, and instrumentation required are presented. Application to real groundwater samples provides a comparison with previously described techniques. The separation of nearby oxidation peaks in potentiometric stripping analysis can be effected by matrix exchange techniques which involve plating in one environment and stripping in another. Flow injection analysis provides a convenient mechanism to automate this process. Heavy metals commonly found in groundwater, such as lead, cadmium, copper, bismuth, and tin, were studied by this technique to explore the scope limits of the method. (Baker-FRC)
W83-04191

CONTINUOUS FLOW DETERMINATION OF FREE CHLORINE IN WATER,
Osaka Prefectural Univ., Sakai (Japan). Lab. of Environmental Chemistry.
T. Aoki, and M. Munemori.
Analytical Chemistry, Vol 55, No 2, p 209-215, 1983. 8 Fig, 2 Tab, 22 Ref.

Descriptors: *Water analysis, *Chlorine, Continuous flow, Water quality, Chemical analysis, Drinking water, Potable water, Quality control, *Pollutant identification.

The continuous determination method is presented for free chlorine, using separation of the molecular chlorine by microporous PTFE tubing and UV absorption of OCl(-) at 290 nm. Molecular chlorine, produced by mixing a sample with 1 N HCl in the outer tube, permeates microporous PTFE and dissolves in 0.1 N NaOH in the inner tube, changing it to ClO(-). The inner solution flows into a UV detector, and ClO(-) is measured spectrophotometrically at 290 nm. UV signals are proportional to concentrations of free chlorine from .00001 to .01 M. The lower limit of detection of free chlorine by this method is .000002 M. The time required for a 98% response is 3 minutes. Free chlorine is selectively measured even in the presence of permanganate, chromate, combined chlorine and heavy metals. There are several advantages to this method. First, the calibration curve is linear over a wide range. Second, it is simple procedure that uses only HCl and NaOH as reagents, and third, it

uses direct measurement of free chlorine and therefore the other oxidant such as monochloramine which interferences with the membrane electrode and probably with the method of Balt does not interfere and can be determined separately. Response can be made 30-40% faster by shortening the tubes used in this system. In this case, 20 samples can be analyzed in an hour. (Baker-FRC)
W83-04192

SIMULTANEOUS DETERMINATION OF SIXTEEN MAJOR AND MINOR ELEMENTS IN RIVER SEDIMENTS BY ENERGY-DISPERSIVE X-RAY FLUORESCENCE SPECTROMETRY AFTER FUSION IN LITHIUM TETRABORATE GLASS,
University of Southern Colorado, Pueblo. Dept. of Chemistry.
K. I. Mahan, and D. E. Leyden.
Analytical Chimica Acta, Vol 147, p 123-131, 1983. 5 Tab, 16 Ref.

Descriptors: *Pollutant identification, *Sediments, *Trace elements, *X-ray fluorescence, X-ray spectroscopy, Fluvial sediments, Trace metals, Lake sediments, Arkansas River, Lake sediments.

Fluvial sediments, including the NBS SRM-1645 Standard River Sediment, were fused in lithium tetraborate to form glass discs on which 16 elements were determined simultaneously under a single set of x-ray conditions by energy-dispersive x-ray fluorescence spectrometry. In the NBS SRM-1645 samples, corrections were required for the fluroescence of chromium by the FeK lines and the absorption of FeK lines by chromium, and for background levels of manganese. At the lowest sample-to-flux ratio (1:10), good agreement was obtained between the results using the present method and the NBS values for all quantifiable elements except zinc. At higher sample-to-flux ratios, agreement with NBS values was generally poorer with increasing sample concentration. The relative standard deviation (RSD) of the eight quantifiable major and minor elements (K, Ca, Ti, Mn, Fe, Zn, Sr and Zr) determined under a single set of x-ray conditions ranged from 2 to 9% with a mean RSD of 4.4% for a set of replicate discs fused with Lake Pueblo/Arkansas River sediment samples. (Geiger-FRC)
W83-04194

EVALUATION OF METHODS BASED ON ACID EXTRACTION AND ATOMIC ABSORPTION SPECTROMETRY FOR MULTI-ELEMENT DETERMINATIONS IN RIVER SEDIMENTS,
University of Southern Colorado, Pueblo. Dept. of Chemistry.
G. S. Caravajal, K. I. Mahan, D. Goforth, and D. E. Leyden.
Analytica Chimica Acta, Vol 147, p 133-150, 1983. 5 Fig, 7 Tab, 57 Ref.

Descriptors: *Pollutant identification, *Trace elements, *Separation techniques, *Fluvial sediments, *X-ray fluroescence, Trace metals, Heavy metal, Sediments, X-ray spectroscopy.

A method is presented for the multi-element analysis of major, minor, and trace metals in sediments by mineral acid extraction and atomic absorption spectrometry (AAS). The technique was applied to the analysis of NBS SRM-1645 and river sediments for the determination of Li, Na, K, Rb, Mg, Ca, Sr, Fe, Mn, Cu, Cd, V, Co, Cr, Ni, As, Sb, Tl, Pb, Zn, Al, Hg and Mo. Results were compared with those obtained by lithium tetraborate fusion, energy-dispersive x-ray fluorescence spectrometry, and electrothermal AAS after digestion of the fused borosilicate glass. Although good accuracy was obtained for most of the elements, low values were obtained for Fe, Cd, Co, Sb and the alkali and alkaline earth metals due to incomplete extraction. A matrix modification technique was required for some minor elements and all trace elements except Mn and Zn. Although electrothermal AAS was effective for most minor and trace elements determined, it is inadequate for the dissolution of major elements in river sediments. (Geiger-FRC)
W83-04195

5B. Sources Of Pollution

THE ORIGIN OF CONTINENTAL SHELF AND SLOPE WATER IN THE NEW YORK BIGHT AND GULF OF MAINE: EVIDENCE FROM H2018/H2016 RATIO MEASUREMENTS,
Lamont-Doherty Geological Observatory, Palisades, NY.
R. G. Fairbanks.
Journal of Geophysical Research, Vol 87, No C8, p 5796-5803, July 20, 1982. 11 Fig, 21 Ref.

Descriptors: *Isotope studies, *Water circulation, *Bights, *New York Bight, Middle Atlantic Bight, *Gulf of Maine, *Saline water, Seawater, Meteoric water, Water currents, Melting, Sea ice, Ice, Oxygen isotopes, Continental shelf, Continental slope, Fate of Pollutants, Rivers, River water.

A combination of isotope and salinity tracers were used to study the general circulation of the seawater in the Middle Atlantic Bight. In this region the ratio of 018 to 016 in meteoric water decreases with increasing latitude. The annual average of the difference in 018 content for the Middle Atlantic Bight and Gulf of Maine rivers are -9.33 o/oo and -10.89 o/oo, respectively. All rivers are enriched by about 2 o/oo during the summer months. Five types of water were identified by isotope ratio measurements: slope water, Scotian shelf surface water, Gulf of Maine surface and intermediate water, cold pool, and New York Bight surface water. Slope water is imported to the New York Bight and is an extension of the Labrador Current. Upper slope water is a mixture of local shelf water and Gulf Stream water. Slope water is also found in the bottom of the Wilkinson Basin, Gulf of Maine. The New York Bight cold pool was renewed from the north during springtime. In March 1977 the cold pool contained as high as 2.75% melt water from sea ice originating in the Gulf of St. Lawrence. This isotope-salinity method can help predict the New York Bight hydrography by monitoring water upstream. (Cassar-FRC)
W83-03856

DECOMPOSITION OF SOLID WASTE IN TEST LYSIMETERS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5E.
W83-03861

EFFECT OF SEWAGE SLUDGE ON TRACE ELEMENT MOBILITY IN SOILS,
Institute for Soil Fertility, Groningen (Netherlands). Dept. of Soil Biology.
R. G. Gerritse, R. Vriesema, J. W. Dalenberg, and H. P. DeRoos.
Journal of Environmental Quality, Vol 11, p 359-364, 1982. 5 Fig, 4 Tab, 25 Ref.

Descriptors: *Adsorption, *Land application, *Sludge disposal, *Trace elements, Fate of pollutants, Land disposal, Heavy metals, Metals, Organic matter, Chelation, Leaching.

The adsorption (distribution between solid and liquid phases) of 26 trace elements was studied in the laboratory in a sandy soil and a sandy loam soil. Aqueous solutions used in the experiments were deionized water, salt solutions, supernatant of industrial anaerobically digested sludge, supernatant of domestic sludge, and supernatants of aerated sludges. F, B, and Tc were very mobile in both soils. Mn, Sr, and Sb were highly mobile only in the sandy soil; Mo in the sandy loam soil. In general sludge solutions increased the mobility of elements in a soil. This was attributed to complexation by organic compounds, high background concentrations, and high ionic strengths. The effects of these variables were very different among the elements. Equations were developed for predicting the rates of accumulation in soils and concentrations in soil solutions for the trace elements. Other elements studied were Be, V, Cr, Fe, Co, Ni, Cu, Zn, As, Se, Ag, Cd, Sn, Cs, Ba, Hg, Pb, Bi, and P. When adsorption was related to soil organic matter content, the strength of adsorption depended only on pH, increasing with decreasing pH for many elements. (Cassar-FRC)
W83-03893

USING EPA'S COMPUTERIZED DATA BASE (STORET) TO ANALYZE FOR AGRICULTURAL WATER POLLUTION,
Virginia State Water Control Board, Richmond. Bureau of Water Control Management.
J. C. Reardon, L. D. Hanson, and J. Randolph.
Journal of Environmental Quality, Vol 11, No 3, p 427-432, 1982. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Agricultural runoff, *Nonpoint pollution sources, *Farm management, Fate of pollutants, Water pollution sources, Phosphates, Nitrates, Nitrites, Coliforms, *STORET, Agricultural wastes, Animal wastes, Cultivation, Runoff, Little Bennett Creek, *Maryland, Farm wastes, Data storage and retrieval, Water quality control.

The computer data base STORET was used to retrieve stream water quality data for a 9-year period for the upper Little Bennett Creek watershed, Maryland. This agricultural watershed contains many large dairy farms which have waste management and storage facilities. During the study period the use of no-till and minimum-tillage corn practices increased by about 90%, and several operators improved their waste control facilities. STORET data from 4 sampling stations were used to relate concentrations of total phosphate, fecal coliforms, and nitrate-nitrite-N data to time. Linear regressions indicated that total phosphate and fecal coliforms decreased with time. Total phosphate data from all sampling stations showed a significant inverse relationship between concentration and time. Only the furthest-upstream station produced a significant relationship between fecal coliform concentrations and time. Nitrate-nitrite regression equations were not significant at any station. Use of the computerized information allowed analysis of data at about one-tenth the cost of a program requiring sampling and laboratory analysis. (Cassar-FRC)
W83-03895

MOBILITY THROUGH SOILS OF CERTAIN HEAVY METALS IN GEOTHERMAL BRINE WATER,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
H. E. Doner, A. Pukite, and E. Yang.
Journal of Environmental Quality, Vol 11, No 3, p 389-394, 1982. 2 Fig, 4 Tab, 17 Ref.

Descriptors: Metals, *Brines, Adsorption, Fate of pollutants, *Heavy metals, *Geothermal studies, Cadmium, Copper, Lead, Zinc, Manganese, Chlorides, Salton Sea, *California, Geochemistry, Soil adsorption capacity, *Path of pollutants.

Geothermal brine from the Salton Sea, California, field was applied to five agricultural soils in laboratory column tests to determine the mobility of heavy metals. Results indicated that accidental spills of the geothermal brine onto the soils of the Imperial Valley would result in contamination of drainage and ground waters with salt and heavy metals. No soils in the study adsorbed Cu(++) from the brine; Cd(++) was removed by some soils. Although all soils adsorbed some Pb(++) and Zn(++), their adsorption capacity was exceeded after passing 10 pore volumes of brine. As determined by the GEOCHEM program, complexation with chloride was extensive in all metals: 100% of Cd and Pb, 80% of Cu and Zn, and 54% of Mn. The high mobility of the heavy metals was attributed to mass action and chloride complexation. (Cassar-FRC)
W83-03896

HEAVY METAL CONCENTRATIONS IN EARTHWORMS FROM SOIL AMENDED WITH SEWAGE SLUDGE,
Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center.
W. N. Beyer, R. L. Chaney, and B. M. Mulhern.
Journal of Environmental Quality, Vol 11, No 3, p 381-385, 1982. 4 Tab, 19 Ref.

Descriptors: *Sludge disposal, Metals, *Invertebrates, Fate of pollutants, Worms, Cadmium, Zinc, Copper, Nickel, Lead, Food chains, Wildlife, *Heavy metals, Land application, Soil amendments, Indicator organisms, Bioindicators.

Earthworms in four agricultural fields amended with sewage sludge contained 12 times more Cd, 2.4 times more Cu, 2.0 times more Zn, and 1.2 times more Pb than at control sites. Ni levels were not elevated. Metals concentrations varied widely among the four sites. Average metals concentrations (ppm dry weight) in sludge exposed earthworms were: Cd, 57; Zn, 452; Cu, 31; Ni, 14; and Pb, 20. Average total metals levels (ppm dry weight) in soil were: Cd, 2.7; Zn, 132; Cu, 39; Ni, 19; and Pb, 31. Generally, Cd and Zn were concentrated by earthworms relative to the soil; Cu, Pb, and Ni were not. Liming the soil had no effect on Zn, Cu, Ni, or Pb levels in worms but reduced Cd concentrations by 40% in the most acidic soil and 11% on the average. Concentrations of Cd, Zn, Cu, and Pb (but not Ni) in earthworms were correlated with those in soil. The ratio of metals concentrations in earthworms/soil was lower in contaminated soil than in clean soil. (Cassar-FRC)
W83-03897

NITROGEN AND PHOSPHORUS MOVEMENT IN COMPOST-AMENDED SOILS,
Maryland Univ., College Park. Dept. of Agronomy.
J. C. Inman, M. S. McIntosh, J. E. Foss, and D. C. Wolf.
Journal of Environmental Quality, Vol 11, No 3, p 529-532, 1982. 4 Fig, 3 Tab, 25 Ref.

Descriptors: *Composting, *Sludge disposal, *Nutrients, Fate of pollutants, Nitrates, *Phosphates, Conductivity, Land application, Land disposal, Trees, *Nitrogen, *Path of pollutants.

Nitrate-N, phosphate-P, and electrical conductivity were monitored for 30 months after application of a composted sewage sludge (65% sludge and 35% wood chips) to a silt loam planted with plots of white pine or hybrid poplar. Sludge was applied on August 10, 1977, at the rate of 0, 150, or 300 dry tons per ha. Nitrate concentrations were highest during the first year following sludge application. In the C horizon (100 cm depth) levels were 11-12 micrograms per ml in the control and 70-80 micrograms per ml in the 300 tons per ha application. Within 2 years after sludge application the nitrate concentrations had declined to < 10 micrograms per ml. Total Kjeldahl N concentrations were 2 and 3 times higher than levels in control soils in the 150 and 300 tons per ha plots, respectively, a month after sludge application. By July 1980 only 3-6% of the total Kjeldahl N had been lost. Phosphate concentrations were generally below 0.08 micrograms per ml in all plots. Average electrical conductivity (EC) values (in micromhos per cm) were: A horizon, 542; B horizon, 405; and C horizon, 694. No visible salt injury was apparent in the pines, poplars, or fescue. On day 267 after application EC values (micromhos per cm) were 1000 in the 300 tons per ha treatment, 700 in the 150 tons per ha treatment, and 200 in the control. By the second spring after application EC had declined to < 400 micromhos per cm on the composted plots. (Cassar-FRC)
W83-03898

WATER QUALITY AND NUTRIENT DYNAMICS OF ARIZONA STREAMS,
Arizona State Univ., Tempe. Dept. of Zoology.
S. G. Fisher, and N. B. Grimm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-253369, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Arizona, Tucson, July 1983. 64 p, 4 Fig, 39 Tab, 29 Ref. OWRT A-106-ARIZ(1), 14-34-0001-1103.

Descriptors: Water quality, *Nitrogen, *Phosphorus, Stream channels, *Arizona, *Nutrients, Streams, Pollutant identification, Water pollution sources, Fate of pollutants.

This reports an investigation of water quality of Arizona streams and rivers with special attention given to nutrient concentrations and dynamics. Samples from one hundred ninety-six sites of 157 streams in Arizona were analyzed chemically with emphasis on nitrogen and phosphorus. Both N and P vary considerably, but N concentrations of floodwater and spring-source sites are significantly higher than sites samples at summer low flow. Nitrate-N declines downstream of spring-sources faster than P, so that N:P at downstream (summer low flow) sites is <15 suggesting potential N limitation. This decline of N is explainable by autotrophic uptake, based on measurements of net production for a stream segment ecosystem and of N uptake by isolated algal communities. Diel nitrogen and phosphorus budgets measured for a 100-m segment of Sycamore Creek, a low desert stream, on three dates during a 30-day recovery period following flash flood decimation of the biota. Transport was dominated by dissolved N and P. Retention of dissolved nutrients by the ecosystem increased with succession, while export of particulate N and P represented a minor loss at later stages of succession. Overall, the results of this study lend support to two hypotheses: (1) If nutrients are limiting to production in Arizona streams, N is the likely candidate. (2) Floodwaters and springs are sources of high N concentration, but reduction of N occurs after floods and downstream of springs, probably due to autotrophic uptake.
W83-03900

AN ANALYTICAL MODEL OF CONTAMINANT MIGRATION IN SHALLOW AQUIFERS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
D. O. Lederer, D. W. Ostendorf, R. R. Noss, and D. D. Adrian.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255505, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 139, Massachusetts Univ., Amherst, May 1983. 70 p, 16 Fig, 11 Tab, 20 Ref. OWRT A-131-MASS(1), 14-34-0001-0123.

Descriptors: *Leachate, *Subsurface flow, *Aquifer management, *Simulation, *Monitoring, Groundwater pollution, Groundwater movement, Percolation, Waste disposal, Model studies, Landfills, Water measurement, Groundwater, New York, Massachusetts, *Path of pollutants.

This study is an attempt to create an easily employable, one-dimensional model of leachate movement away from large, diffuse sources such as sanitary landfills, over long time periods in shallow aquifers. The approach used is one in which a number of lumped parameter cells are placed in series to simulate plug flow in the groundwater system. The lumped parameter modelling scheme models time very carefully, yet describes space on an average basis. After solution of the governing differential equations, the model is verified using data from Babylon, New York and Amherst, Massachusetts landfills.
W83-03909

ASSESSMENT OF ACIDITY OF LAKES AND PRECIPITATION IN THE SIERRA NEVADA,
California Univ., Santa Barbara. Marine Science Inst.
J. M. Melack.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255521, Price codes: A04 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, June 1983. 62 p, 14 Fig, 6 Tab, 65 Ref, 2 Append. OWRT-A-080-CAL(1).

Descriptors: *Acid rain, *Lakes, *Mountain lakes, Acidic water, Acids, Precipitation, Environmental effects, Pollution effects, Air pollution effects, Aquatic environment, *California, Sierra Nevada, Oligotrophic lakes.

The east central Sierra Nevada received acid precipitation (pH 3.7 to 4.9) during the convective storms interspersed through the dry seasons of 1981 and 1982. In contrast, late autumn, winter and early spring snow (1981-82) ranged in pH from 5.2 to 6.1 (mean 5.7) and had low ammonium, nitrate and sulfate concentrations. As of 1981 most of the alpine lakes of the Sierra Nevada remain very weakly buffered, bicarbonate lakes that receive a small loading of acid precipitation and a large annual input of snowmelt uncontaminated by strong acids. These lakes contain low concentrations of orthophosphate, nitrate and ammonium and are oligotrophic. The zooplankton communities fall into two major groups, those dominated by large-bodied species in the absence of fish, and those dominated by smaller species where fish are present. If the acidity of the precipitation increases the pH of the lakes will decrease rapidly with adverse biological impacts because the lakes and their basins have extremely low buffer capacity and the biota cannot tolerate acidic water. (Snyder-California)
W83-03911

MULTIPORT DIFFUSER DESIGN FOR DISCHARGING POLLUTANTS IN ALABAMA'S RIVERS,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W83-03912

RAW WATER BROMIDE: LEVELS AND RELATIONSHIP TO DISTRIBUTION OF TRIHALOMETHANES IN FINISHED DRINKING WATER,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 5F.
W83-03916

EFFECTS OF DETERGENT FORMULATION ON THE PERFORMANCE OF SEPTIC SYSTEMS,
J. M. Harkin, B. Al-Hajjar, and D. G. Kroll.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-257543, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center Publication No WIS WRC 83-09, 1983. 64 p, 1 Fig, 8 Tab, 53 Ref, 2 Append. OWRT B-108-WIS(1), 14-34-0001-0257.

Descriptors: *Septic Wastewater, *Detergents, *Phosphorus, Nitrates, Ammonium, Bacteria, Solids, Conductivity, Hydrogen ion concentration, Temperature, *Carbonate detergent, *Septic tanks, Wastewater treatment, Water quality control.

The intent of this study was to monitor the condition on a monthly basis of closely matched new septic systems and to examine their effects on the quality of groundwater, depending on whether laundry was washed in phosphate or carbonate detergent. The septic tank exerts a buffering effect that overcomes the differences that phosphate or carbonate builders create. Virtually no differences are observed in average pH or alkalinity in the tank. However, differences are observed in numbers of indicator organisms; counts for total coliforms, fecal coliforms and fecal streptococci are 1.4, 2.9 and 4.5 times higher in effluent from systems receiving P detergents. Of greatest importance to water quality are the P data. For the first time, reliable estimates can be given of the relative contribution of P from detergents to household wastewater. Hitherto estimates have been based on values for municipal wastewater, which is confounded by P inputs from industrial plants or hospitals, where P detergents were permitted despite bans on household use. 40% of the P in sewage comes from laundering. More important is that groundwater contamination by P did not occur at any site regardless of whether P-built or P-free deterget was used. Obviously all of the P in septic tank effluent is removed by soil, regardless of its sandy texture at each site. Apart from ammonium or nitrate contamination, septic systems have only minor effects on groundwater. For nitrate it is irrelevant which detergent is used. Nitrate levels in groundwater near systems deploying periodic pressurized dosing are lower than for those under randomly dosed conventional systems. In sum-

mary, it makes little difference to the operation, performance, or biological clogging of a septic system whether the household uses exclusively P- or P-free detergents. Neither type of detergent results in entry and movement of P into groundwater.
W83-03924

THE INFLUENCE OF SURFACTANTS ON THE ADSORPTION OF HEAVY METAL IONS BY CLAYS,
Newcastle Univ. (Australia). Dept. of Chemistry.
A. Beveridge, and W. F. Pickering.
Water Research, Vol 17, No 2, p 215-225, February, 1983. 6 Fig, 1 Tab, 26 Ref.

Descriptors: *Heavy metals, *Surfactants, *Adsorption, *Clays, Copper, Zinc, Lead, Cadmium, Ions, Suspended solids, Fate of pollutants, Laboratory studies.

The effects of low concentrations of a series of anionic, cationic, and nonionic surfactants available commercially on the uptake of copper, lead, zinc, and cadmium by three types of clays (kaolinite, illite, and a montmorillonite) were investigated over the pH range 3 to 10. The phase distribution process was influenced by low concentrations (less than 0.005% weight/volume) of charged surfactants, but much higher concentrations (greater than 0.1% weight/volume) of nonionic species were necessary to produce observable effects. The cationic surfactants reduced metal ion uptake by montmorillonite suspensions by competing for surface sites, but had much smaller effects on metal ion uptake by the other two clays. The addition of anionic surfactants led to increased metal loss from solution, probably as a result of precipitation of sparingly soluble metal-surfactant species. The effects of the nonionic organics studied (all ethoxylates) varied with the type of clay and the specific metal ion involved. The concentrations used were of the order required for micelle formation, and it appears that the micelles became involved in the metal ion distribution process. The presence of surfactant reduced the amount of metal ion sorbed by montmorillonite clays, but evidence of a reduction in adsorption site availability in kaolinite and illite suspensions was apparent in only a few of the systems studied. Most of the remaining systems caused some enhanced loss of the metal ion form solution. Few of the added surface active agents significantly influenced the pH at which the metal ions precipitated as hydroxy species. It is suggested that, since the more widely used surfactants in detergent preparations tend to be anionic species, contamination of waterways by these materials will have at least one beneficial effect: namely, that the levels of heavy metal ions in solution should either be reduced or remain unaltered. (Carroll-FRC).
W83-03935

DYNAMIC ESTIMATES OF RIVER POLLUTION UNDER CONDITIONS OF REGULATION OF THE RIVER AND ANTHROPOGENIC RUNOFF,
I. V. Gordin.
Water Resources (English Translation), Vol 8, No 4, p 402-409, July/August, 1981. 4 Fig, 7 Ref. Translated form Vodnye Resursy, No 4, p 108-117, July/August, 1981.

Descriptors: *Fate of pollutants, *Dynamics, Mathematical studies, Concentration, Water management, Water quality control, Mathematical equations, Monitoring, Rivers, Water pollution sources, Runoff, Streamflow, *USSR.

To aid in optimizing water-quality regulation in water conservation systems, the change in concentration of a given pollutant at a certain control section with time was investigated mathematically. The problem of the optimal regulation of water quality is formulated with respect to three criteria of statistical dynamics: the maximum value of the concentration, the integral value during the period of interest, and the integral square value. The calculations suggest that the problem of a dynamic estimate of the pollution of rivers under conditions of regulating the river and anthropogenic runoff apparently cannot be solved uniquely by developing a universal criterion. At the same time, the estimates examined in the paper give a sufficiently clear idea about the comparative effectiveness of various methods of regulation and reveal interesting regularities of water quality management in industrially polluted streams. (Baker-FRC)
W83-03937

CHEMICAL WATER QUALITY OF RUNOFF FROM GRAZING LAND IN NEBRASKA: II CONTRIBUTING FACTORS,
Agricultural Research Service, Lincoln, NE.
J. S. Schepers, B. L. Hackes, and D. D. Francis.
Journal of Environmental Quality, Vol 11, No 3, p 355-359, 1982. 1 Fig, 5 Tab, 10 Ref.

Descriptors: *Grazing, *Farm wastes, *Nonpoint pollution sources, Farm management, Livestock, Pastures, *Nebraska, Precipitation, Runoff, Agricultural runoff, Water quality, Animal wastes, Manure, Vegetation, Wildlife, Nutrients, Organic matter, Nitrates, Phosphorus, Chlorides, Ammonium, Water pollution sources, Fate of pollutants, Pastures.

The effects of climatic factors, hydrologic factors, and management practices on the chemical quality of runoff from a 32.5 ha cow and calf pasture in Nebraska were studied in 1976-78. Precipitation and hydrologic characteristics, stocking rates, and sediment contents in the runoff were used to predict the average concentrations of ammonium-N, nitrate-N, Kjeldahl N, soluble P, total P, total organic carbon, COD, and chloride. Animal stocking density significantly influenced the predicted concentrations of ammonium-N, nitrate-N, total P, total organic carbon, and COD in the runoff. However, dilution was the dominant process. Likely sources of pollutants were standing plant material and manure. Chloride appeared to be an indicator of wildlife activity. (Cassar-FRC)
W83-03967

PLANT AND SOIL REACTIONS TO NICKEL ORE PROCESSED TAILINGS,
Oregon State Univ., Corvallis. Dept. of Soil Science.
P. J. Sheets, V. V. Volk, and E. H. Gardner.
Journal of Environmental Quality, Vol 11, No 3, p 446-451, 1982. 2 Fig, 5 Tab, 31 Ref.

Descriptors: *Nickel, *Mine wastes, *Revegetation, Metals, Heavy metals, Plant growth, Water pollution effects, Water pollution sources, Ammonium, Conductivity, Dissolved solids, Grasses.

The effect of nickel ore tailings, produced by a proposed reduction-leaching procedure, on plant growth and soil properties was studied. The tailing material contained high levels of some heavy metals, ammonia, and soluble salts and low concentrations of P and Ca. Magnesium and ammonium sulfates were largely responsible for the high electrical conductivity of the tailings, 8.4 mmhos per cm. Ammonium-N was 877 micrograms per g; Ni, 0.28%, Cr, 0.44%; and Fe, 32%. Five pore volumes were required to reduce the electrical conductivity to 0.8 mmhos per cm, acceptable for irrigation water. Tall fescue was grown in green house experiments, using the local serpentinic soil and tailings added at the rates of 0, 22, 446, and 669 g per kg soil as well as in 100% tailings. Establishment of the grass was slow on soils amended at the highest rate and on pure tailings because of the high levels of soluble salts and ammonia. However, total seasonal yields of dry matter were comparable in all treatments. It was recommended that the tailings be washed to reduce ammonia and soluble salts before revegetation and that native soil be added to reduce crusting. (Cassar-FRC)
W83-03976

A PROPOSAL FOR ESTIMATION OF SOIL LEACHING AND LEACHING CONSTANTS FOR USE IN ASSESSMENT MODELS,
Oak Ridge National Lab., TN.
C. F. Baes, III, and R. D. Sharp.
Journal of Environmental Quality, Vol 12, No 1, p 17-28, January/March, 1983. 7 Fig, 5 Tab, 85 Ref.

Descriptors: *Solute transport, *Leaching, *Fate of pollutants, Model studies, Infiltration, Distribution coefficient, Soil properties, Soil density.

A model to predict annual average, order of magnitude leaching constants for solutes in agricultural soils is developed. The leaching constants, which are solute- and location-specific, are usable in exposure, dose, or risk assessment models to account for removal from the root zone by leaching. The model relates annual average water infiltration with soil bulk density and porosity and the solute's distribution coefficient. Annual infiltration is determined from site-specific estimates of total precipitation, irrigation, and evapotranspiration. Soil bulk density and porosity have geometric mean values of 1.35 g per cu cm and 0.48 cu cm per cu cm, respectively, and vary within a factor of 3. The solute distribution coefficient varies widely and unpredictably, depending on solute and soil characteristics, especially pH. A table lists ranges of distribution coefficients for 27 elements in a variety of soils and from pH 4.5 to 9.0. For example, the distribution coefficient for plutonium varies between 11 and 300,000. Leaching constants predicted for Pu, Sr, and Tc were within an order of magnitude of observed data for 8 comparisons, except for 1 study involving Pu. (Cassar-FRC)
W83-03978

DETERMINATION OF ALGAL-AVAILABLE PHOSPHORUS ON SOIL AND SEDIMENT: A REVIEW AND ANALYSIS,
Pennsylvania Univ., Philadelphia. Dept. of Civil and Urban Engineering.
D. A. Hegemann, A. H. Johnson, and J. D. Keenan.
Journal of Environmental Quality, Vol 12, No 1, p 12-16, January/March, 1983. 63 Ref.

Descriptors: *Sediments, *Phosphorus, *Algae, Reviews, Soil, Nutrients, Bioassay, Agricultural runoff, Phosphates, Fate of pollutants, Lake sediments, Bottom sediments.

Recent research on algal-available phosphorus associated with soil and sediments is reviewed. The bioassay and chemical fractionation procedures were nonuniform and involved site-specific soils, making quantitative comparisons difficult. Many studies showed that some of the Fe- and Al-bound P is available to algae in bioassays. However, it has not been shown that all the P extracted from the non-apatite fraction is algal-available. Stable organic P in soils and sediments appears to be of very limited availability, depending on environmental conditions and the degree of bacterial action, which liberates orthophosphate. It is reported that from 0 to 80% of total soil P is available to algae. The short-term batch culture assays most likely do not identify the total quantity of algal-available P. Longer-term experiments (longer than 100 days) would probably give more accurate results. (Cassar-FRC)
W83-03979

ADSORPTION AND DEGRADATION OF PHENOL AT LOW CONCENTRATIONS IN SOIL,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
H. D. Scott, D. C. Wolf, and T. L. Lavy.
Journal of Environmental Quality, Vol 12, No 1, p 91-95, January/March, 1983. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Phenol, *Adsorption, *Degradation, Fate of pollutants, Biodegradation, Microbial degradation, Soil.

Degradation rates and half-lives of phenol in silt loams were essentially independent of concentration over the range 94 ng per g to 94 microg per g of soil. However, mean degradation rates differed between the 2 soils, 0.260 and 0.198 per hour. Half-lives for the 2 soils were 2.70 and 3.51 per hour. For sterile soil the adsorbed concentration was more variable than the solution concentration. For nonsterile soil the variabilities of adsorbed and solution concentrations were greater than for sterile soil. Freundlich K values increased to a maximum at 12 hours of equilibration between phenol and both soils. Little or no effect was found on the

Freundlich N values. Data suggest that sterilization of soil increases the precision of adsorption measurements. (Cassar-FRC)
W83-03980

CHEMICAL WATER QUALITY OF RUNOFF FROM GRAZING LAND IN NEBRASKA: I. INFLUENCE OF GRAZING LIVESTOCK,
Agricultural Research Service, Lincoln, NE.
J. S. Schepers, and D. D. Francis.
Journal of Environmental Quality, Vol 11, No 3, p 351-354, 1982. 3 Tab, 18 Ref.

Descriptors: *Grazing, *Farm wastes, *Nonpoint pollution sources, Pastures, *Nebraska, Runoff, Water quality, Farm management, Animal wastes, Manure, Vegetation, Wildlife, Nutrients, Organic matter, Nitrates, Phosphorus, Chlorides, Ammonium, Water pollution sources, Fate of pollutants, Livestock.

The quality of runoff water from a 32.5 ha cow and calf pasture in Nebraska was studied for three years, 1976-78. Three types of pastures were included: ungrazed pasture (control), grazed pasture with livestock actively grazing, and grazed pasture with livestock absent. The runoff water from pasture with actively grazing livestock had higher concentrations of all water quality parameters with respect to the grazed pasture with no livestock present, with the exception of Kjeldahl N, which decreased by 19%. The increases were: total solids, 52%; total organic carbon, 11%; COD, 7%, ammonium-N, 6%, nitrate-N, 45%; total P, 37%; soluble P, 48% and chloride, 78%. Runoff from the control area was tea-colored and had the poorest quality, with 1.94 to 10.8 times greater concentrations of pollutants. This was attributed to wildlife activity and leaching of nutrients and organic matter from vegetation. (Cassar-FRC)
W83-03981

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN: V. PESTICIDE USE IN 11 AGRICULTURAL WATERSHEDS AND PRESENCE IN STREAM WATER, 1975-1977,
Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
R. Frank, H. E. Braun, M. V. H. Holdrinet, G. J. Sirons, and B. D. Ripley.
Journal of Environmental Quality, Vol 11, No 3, p 497-505, 1982. 13 Tab, 35 Ref.

Descriptors: *Pesticides, *Agricultural watersheds, *Great Lakes, *Ontario, Insecticides, Herbicides, Fungicides, Nematocides, Fate of pollutants, Atrazine, Water qualtity, Streams, Watersheds, Pollution load, Agricultural runoff, Runoff, Water pollution sources, Nonpoint pollution sources.

A survey of pesticide use in 11 agricultural watersheds in southern Ontario showed that 81 pesticides were applied during 1975 on 39% of the land surface at a rate of 8.27 kg per ha per year. This was equivalent to 3.25 kg per ha per year over the whole area. Analysis of stream water samples from the 11 watersheds revealed 41 pesticides that were on the list of materials applied. Drainage waters contained 18 parent compounds, 3 metabolites, and 1 industrial organic pollutant. DDT, TDE, and HEOD were identified in water samples although they have not been used for several years. Several pesticides (atrazine, endosulfan, and simazine) were persistent enough to appear in water samples throughout the year. The overall unit area loading to streams by pesticides was 2.18 g per ha per year, of which atrazine accounted for 2.01 g per ha per year. Pesticides entered the stream water from storm runoff waters (60%), in base flow from internal soil drainage (18%), and from spills adjacent to streams (22%). Those chemicals whose levels exceeded the International Joint Commission water quality standards were polychlorobiphenyls (78% of samples), total DDT (41% of samples), HEOD (16% of samples), endosulfan (14% of samples), and heptachlor epoxide (14% of samples). (Cassar-FRC)
W83-03982

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN: I. REPRESENTATIVE AGRICULTURAL WATERSHEDS,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
D. R. Coote, E. M. MacDonald, W. T. Dickinson, R. C. Ostry, and R. Frank.
Journal of Environmental Quality, Vol 11, No 3, p 473-481, 1982. 1 Fig, 8 Tab, 16 Ref.

Descriptors: *Agricultural watersheds, *Great Lakes, *Ontario, Monitoring, Water quality, Pollution loads, Fate of Pollutants, Water pollution sources, Nonpoint pollution sources, Watersheds, Clays, Streams, Agricultural runoff, Runoff, Erosion, Fertilizers, Tile drainage, Livestock, Animal wastes, Farm wastes, Farm management, Land use.

Eleven representative agricultural watersheds in the southern Great Lakes drainage basin were chosen for monitoring as part of the PLUARG study on pollution loads. The regions were separated according to an index measuring the soil's potential to transfer pollutants to surface and groundwater. This index was strongly correlated with soil clay content. Study regions were 1,990 to 7,913 ha in area, 22 to 89% cultivated, 0 to 99% tile drained, 10 to 66% row-cropped, and stocked with up to 0.77 units of livestock per ha. During January-April 32% of the annual precipitation and 65% of the stream discharge were measured. Erosion potential was significantly positively correlated with row crops, fertilizer N, and tile drainage density. (Cassar-FRC)
W83-03983

COMPARATIVE MOVEMENT OF DIFFERENT ENTEROVIRUSES IN SOIL COLUMNS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
J. C. Lance, C. P. Gerba, and D. -S. Wang.
Journal of Environmental Quality, Vol 11, No 3, p 347-351, 1982. 4 Fig, 4 Tab, 15 Ref.

Descriptors: *Viruses, *Wastewater disposal, *Adsorption, Fate of pollutants, Land application, Soil absorption capacity, Coliforms, Bacteria, Enteroviruses, *Path of pollutants.

Secondary sewage effluents seeded with Echo 1, Echo 29, and Polio 1 viruses were applied to 250 cm long soil columns to study adsorption and leaching patterns. Adsorption in the top 2 cm of soil was 90% for Echo 29 and Polio 1, 77% for Echo 1. All three viruses similarly below the 40 cm depth, at which about 1% of virus remained. At the 160 cm depth, virus removal was >99.9%. Virus leaching patterns reacted similarly to changes in virus concentration and flow velocity. Virus removal efficiencies varied widely among three sand and sandy loam soils, but the leaching patterns of the viruses were similar for a given soil type. The fates of fecal coliforms and poliovirus were roughly parallel, with more viruses than coliforms being removed in the surface layer. At the 130 cm depth removal of both coliforms and viruses was >99.9%. (Cassar-FRC)
W83-03984

DISPOSAL OF FEEDLOT-LAGOON WATER BY IRRIGATING BROMEGRASS: II. SOIL ACCUMULATION AND LEACHING OF NITROGEN,
Kansas Agricultural Experiment Station, Manhattan. Dept. of Agronomy.
R. V. Olson, R. V. Terry, W. L. Powers, C. W. Swallow, and E. T. Kanemasu.
Journal of Environmental Quality, Vol 11, No 3, p 400-405, 1982. 5 Fig, 5 Tab, 15 Ref.

Descriptors: *Wastewater irrigation, *Nitrogen compounds, *Leaching, *Bromegrass, Grasses, Feedlot wastes, Animal wastes, Farm wastes, Irrigation, Nitrates, Fate of pollutants, Ammonium, Denitrification.

Beef feedlot lagoon water was applied to bromegrass fields at the rates of 0, 2.5, 5.1, 7.6, and 10.2 cm per irrigation on 17 occasions over a 4 year period. N concentrations of the applied water varied from 23 to 222 mg per liter, with 1 to 141 mg per liter nitrate-N. Total N contents in the profile increased during the experiment with the 1.2 cm treatment and decreased with the 5.1 cm treatment. At the end of the experiment 56.7 kg N per ha of the 945 kg per ha applied in the 5.1 cm treatment and 136.1 kg per ha of the 1890 kg per ha applied in the 10.2 cm treatment had leached below 105 cm. The amounts of N leached and the N levels in the leachate were not sufficient to adversely affect groundwater quality in the plots during the study period. The linear relationship between amounts of labeled ammonium-N added and labeld N found in the 0-70 cm layer was highly significant. Most of the labeled N was in the top 10 cm, 88-94% of it immobilized in the organic form. With the 5.1 cm treatment 28% of the labeled N applied as ammonium was in the soil profile, 41% was used by the crop, 31% lost as a gas, and 0.7% leached below 105 cm. With the 10.2 cm treatment 20% was in the soil, 38% used by the crop, 40% lost as gas, and 1.3% leached. (Cassar-FRC)
W83-03986

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN: II. FLUVIAL SEDIMENTS,
Department of Agriculture, Guelph (Ontario). Inst. of Pedology.
G. J. Wall, W. T. Dickinson, and L. J. P. Van Vliet.
Journal of Environmental Quality, Vol 11, No 3, p 482-486, 1982. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Agricultural watersheds, *Great Lakes, *Suspended sediments, *Ontario, Sediments, Erosion, Fate of pollutants, Water pollution sources, Nonpoint pollution sources, Agricultural runoff, Runoff, Watersheds, Water quality, Streams, Farm management, Pollution load.

A study of 11 small agricultural watersheds in southern Ontario showed that unit area yields of suspended sediments ranged from < 100 to 1000 kg per ha per year during 1976-76. Bank erosion contributed an estimated 0 to 30% of the suspended sediment; cropland sheet and rill erosion, 70-100%. Regression analysis of 14 watershed characteristics vs. unit area yields showed that % clay of the surface soil and % row crop were the most significant factors in estimating suspended sediment yields. Three methods for predicting suspended sediment yields were compared: a regression equation developed from the watershed studies, extrapolation of measured unit are yields obtained from the agricultural watersheds to similar areas in the Grand and Saugeen basins, and the Universal Soil Loss Equation plus a delivery ratio. The third method proved unsuitable for the Canadian climate. Suspended sediment yield from agricultural land in each of 300 subwatersheds in the lower Canadian Great lakes Basin was determined by extrapolation. Estimated suspended sediment yield from agricultural land in the southern Ontario portion of the Great Lakes basin was 652,872 tons per year: almost 300,000 tons per year each into Lakes Huron and Erie, the remainder into Lake Ontario and Georgian Bay. (Cassar-FRC)
W83-03987

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN: IV. NITROGEN,
Department of Agriculture, Summerland (British Columbia). Research Station.
G. H. Neilsen, J. L. B. Culley, and D. R. Cameron.
Journal of Environmental Quality, Vol 11, No 3, p 494-497, 1982. 1 Fig, 4 Tab, 25 Ref.

Descriptors: *Agricultural watersheds, *Great Lakes, *Nitrogen, *Ontario, Watersheds, Pollution load, Water polution sources, Nonpoint pollution sources, Fate of pollutants, Animal wastes, Farm wastes, Water quality control, Streams, Nitrates, Farm management, Clays, Agricultural runoff, Runoff, Fertilizers, Seasonal variation, Livestock.

Total Kjeldahl N and nitrate-N were sampled in stream runoff in 11 agricultural watersheds in southern Ontario during 1975-76. Of the 3000 sam-

ples, nitrate levels exceeded the 10 mg per liter drinking water standard in 3%. About half of the high concentrations occurred June and July storms and were associated with intense agricultural land use. Average annual total nitrogen stream loads were 3.5 to 29.2 kg N per watershed ha for the years 1975 and 1976. Nitrate accounted for an average of 75% of the total stream N loads. Both nitrate and total N loads were significantly correlated with addition of N to the watershed and with % of watershed under cultivation, in row crops and corn, or tile drained. Total N was also correlated with surface soil clay content and with extent of soils with high surface runoff potential. It was recommended that stream N loading be reduced in watersheds where loading greatly exceeds inputs of N from precipitation. In these watersheds the greatest potential for reducing N loads is improved fertilizer efficiency in corn production. Athough manure storage areas and feedlots did not contribute greatly to total N loads, proper waste management methods are important. 71% of the nitrate-N and total N loading occurred in January-April. (Cassar-FRC)
W83-03988

MINERALOGICAL CONTROLS ON TOXIC ELEMENT CONTAMINATION OF GROUNDWATER FROM BURIED ELECTRICAL UTILITY SOLID WASTES: I. SOLID WASTE MINERALOGY II. LITERATURE REVIEW OF FLY ASH MINERALOGY,
North Dakota State Univ., Fargo.
G. J. McCarthy, K. D. Swanson, P. J. Schields, and G. H. Groenewold.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265116, Price codes: A04 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute Completion Report, North Dakota State Univ., Fargo, August 1983. 59 p, 7 Tab, 36 Ref. OWRT A-078-NDAK(1), 14-34-0001-2136.

Descriptors: *Mineralogy, *Coal mine wastes, Wastes, Water pollution sources, Fly ash, X-ray diffraction, Quartz, Anhydrite, Lime, Water treatment, *North Dakota, *Groundwater pollution, Waste disposal.

Knowledge of the mineralogy of coal conversion wastes is essential science underlying either environmentally safe disposal or utilization of these wastes. Groundwater contamination is possible if these wastes are not disposed of properly. The fly ash samples from the Milton R. Young (MRY) and Coal Creek (CC) plants were dominantly noncrystalline glass. X-ray diffraction was used to identify the following crystalline phases in both samples: quartz, periclase, ferrite spinel, anhydrite and lime. The MRY fly ash also had alkali sulfates and a small amount of melilite solid solution phase. Devitrification treatments and water treatments aided in these phase identifications. The possible presence of tricalcium aluminate (C A) was noted but this phase could not be unambiguously identified in any of the x-ray diffractograms. The implications of these results for groundwater quality and utilization of these solid wastes is discussed. In addition to the mineralogy studies, ash buried as much as twelve years ago at the mine site adjoining the MRY plant was collected as undisturbed core that incorporated the materials above and below the ash disposal horizon. The sealed core samples are being kept frozen in anticipation of a follow-up investigation of the changes in mineralogy and migration of species from the buried waste.
W83-04004

ALTERATION OF AVAILABILITY OF HEAVY METALS TO AQUATIC MICROFLORA BY COMPLEXATION WITH ORGANICS ASSOCIATED WITH OIL SHALE DEVELOPMENT,
Utah Water Research Lab., Logan.
B. S. Mok, and J. J. Messer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265132, Price codes: A07 in paper copy, A01 in microfiche. Water Quality Series UWRL/Q-83/05, May 1983. 135 p, 33 Fig, 27 Tab, 110 Ref, 5 Append. OWRT A-051-UTAH(1), 14-34-0001-1147.

Descriptors: *Heavy metals, *Copper, *Cadmium, *Oil shale, *Leachates, Water pollution sources, Nickle, Humic acids, Fulvic acids, Detoxification, Bioassay, Toxins, Nutrients, *Algal bioassay, Water pollution effects, *Selenastrum.

Oil shale process waters and leachates were examined to determine their propensity to complex with heavy metals and create environmentally harmful soluble toxic substances. Leachates from both raw (unretorted) and Paraho retorted oil shale showed tha ability to bind copper, and perhaps cadmium, strongly enough to mitigate the normally inhibitory effects of these metals on the growth of the test alga, Selenastrum capricornutum. In contrast, no detoxification of nickel was observed. For both leachates, the organic fraction large enough to be retained by a UM2 ultrafilter was stimulatory to algal growth both in the presence and absence of added metals, possibly because they supply trace metal nutrients (e.g. iron) or detoxify trace metal toxicants (e.g. copper) through complexation equilibria. The smallest size fraction of the raw shale leachate, consisting of inorganic ions and small organic ions capable of passing a UM2 ultrafilter, was highly toxic to the test alga. The corresponding fraction of retorted shale was less toxic. The nature of the copper complexation by the oil shale leachate organics suggests the binding of this metal by natural humic and fulvic acids in aquatic systems. The complexation does not appear to be caused by the low-molecular weight ring-N compounds characteristic of retort water. Oil shale leachates are thus only likely to increase copper and cadmium binding and transport significantly in waters whose total organic carbon concentration exceeds that contributed by natural humic and fulvic materials.
W83-04006

THE CONTAMINATION AND PROTECTION OF AQUIFERS,
National Hydrology Research Inst., Ottawa (Ontario).
R. E. Jackson.
Nature and Resources, Vol 1, No 3, p 2-6, July/September, 1982. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Aquifer management, *Water pollution sources, Water pollution control, Regulations, United Nations, Groundwater, Water supply, Hydrocarbons, Nitrates, Heavy metals, Organic compounds, Industrial wastes.

The growing presence of contaminants in major water resources such as lakes or rivers and the pollution of aquifers underlying many cities in the world make proper management of groundwater imperative. Scientific evidence suggests that the continued and poorly regulated disposal of waste in dumpsites, landfills, deep wells, lagoons and other places is producing progressive and largely irreversible contamination of groundwater. Of particular concern is the apparent accumulation and persistence in groundwater of hydrocarbons from accidental spills and leaks; nitrate derived from groundwater activities; and heavy metals and toxic organic compounds from industrial operations. For the less developed countries a fourth concern must be added, that of bacterial contamination of shallow wells by seepage from nearby sanitation units. Although naturally occurring physical, chemical and bilogical processes may attenuate contaminants, these processes have finite limits do not lead in many cases to the self-purification of the contaminated groundwaters. Government regulation of waste-disposal activities and protection of aquifer systems along European lines is one possible solution. However, organizations such as MNESCO, through its International Hydrological Program, are working to sensitive hydrogeologists, engineers and public health officials to the dangers of allowing contamination to grow unchecked and to ways of protecting this resource. (Baker-FRC)
W83-04020

INTERFLOW OF WATER THROUGH A SLOPING SOIL WITH SEEPAGE FACE,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2G.
W83-04040

HEAVY METALS IN MARINE ORGANISMS OF THE NORTH AEGEAN SEA, GREECE,
Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
G. Vasilikiotis, K. Fytianos, and A. Zotou.
Chemosphere, Vol 12, No 1, p 75-81, 1983. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Heavy metals, *Marine animals, Lead, Mercury, Cadmium, North Aegean Sea, *Greece, Fate of pollutants, Spectrophotometry.

Concentrations of heavy metals were measured in marine organisms to determine whether they contained concentrations which would be hazardous to human health. All the marine organisms examined had a Cd concentration of less than 0.2 ppm. Highest lead values were 950 micrograms/kg and were found in the Kavala Gulf and in Thermaikos Gulf, which are the most highly polluted of the sampling areas. Mercury concentrations varied according to the sampling area. It was concluded that the concentrations of the heavy metals investigated in marine organisms were relatively low and close to those found in literature for unpolluted regions. The findings also show that the heavy metal concentrations are considerably higher near industrial areas and in ports. From these findings it is concluded that the Strymonikos Gulf is still unpolluted in comparison to the other two areas examined. No seasonal functuations were noted at any of the sites. Comparing the present values to those obtained during 1977-1980 for the same species and sampling areas, it is noted that a slight increase in mercury and lead concentrations occurred in all samples. Cadmium concentration was slightly decreased, but only in fish tissues. (Baker-FRC)
W83-04051

PHOTOLYSIS OF NITROAROMATICS IN AQUATIC SYSTEMS. I. 2,4,6-TRINITROTOLUENE,
SRI International, Menlo Park, CA. Physical Organic Chemistry Dept.
W. R. Mabey, D. Tse, A. Baraze, and T. Mill.
Chemosphere, Vol 12, No 1, p 3-16, 1983. 2 Fig, 7 Tab, 13 Ref.

Descriptors: *Fate of pollutants, *Photolysis, *Trinitrotoluene, Organic compounds, Rivers, Natural waters, Streams, Light, Water depth, Shallow water, *Nitroaromatics.

The photolysis of 2,4,6-trinitrotoluene (TNT) was studied in aqueous solution to estimate the rates of transformation and transport of munitions chemicals in aquatic systems of interest to the US Army. In applying the findings to the environmental photolysis rate constants for TNT it is noted that although TNT photolyzes more rapidly in natural waters than in pure water it is useful to know the direct photolysis rate constants of TNT in sunlight in pure water as limiting (minimum) rate constants that can be expected in aquatic systems. For direct photolysis rate constants for TNT, it is the rate constant before rate acceleration by products that is relevant to environmental assessments, and thus the reaction quantum yield of .0027 is used for rate constant calculations. The products do accelerate the rate of photolysis, and thus rate constants measured in pure water would be expected to show a dependence on initial TNT concentration and the amount of TNT reacted if the TNT concentration is greater than 1 ppm. Even direct photolysis of TNT is a reasonably rapid process in aquatic systems. Photolysis of TNT in several natural waters is shown to be more rapid than in pure water, and thus TNT will photolyze very rapidly in aquatic systems of shallow depth and low absorbance. While the mechanism for photolysis of TNT is not known, evidence suggests that the photolysis may be occurring via a triplet-excited state. The products from TNT show an exceptional ability to promote TNT photolysis. (Baker-FRC)
W83-04055

CONCENTRATION OF HEAVY METALS IN SEAWATER AND SEDIMENTS FROM THE NORTHERN AEGEAN SEA, GREECE,

Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
K. Fytianos, and G. S. Vasilikiotis.
Chemosphere, Vol 12, No 1, p 83-91, 1983. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Heavy metals, *Marine environment, Lead, Copper, Mercury, Zinc, Cadmium, Manganese, Nickel, Fate of pollutants, Water pollution sources, Aegean Sea, Greece, Thermaikos Gulf, Kavala Gulf.

The distribution of heavy metals was studied in seawater and sediments in areas which face increasing marine pollution problems in the closed gulfs of Thermaikos and Kavala in the north Aegean sea. Compared to other regions of the world, concentrations of heavy metals were higher in these study areas, which may be due to the geological configuration of the Thessaloniki gulf and to the increasing pollution from industrial waste and domestic sewage. Significant seasonal fluctuations of heavy metal concentrations were not found, except for a slight increase in the beginning of winter. This may be due to the rainfalls at this time, which wash off street dust rich in heavy metals, especially lead. Heavy metal concentrations in sediments show that lead existed in only a small portion of the waters, the main portion being combined with suspended elements; however, for zinc the opposite is true. It was concluded that the concentration of the heavy metals in water and sediments is higher than in other regions. The Gulf of Kavala is less polluted than Thermaikos Gulf. The present situation could be improved if the planned chemical and biological treatment for industrial waste and domestic sewage were started immediately. (Baker-FRC)
W83-04056

GROUNDWATER PROTECTION - SUFFICIENT AGAINST THREATS TO PUBLIC WATER SUPPLY DUE TO GROUNDWATER POLLUTION. (GRUNDWASSER-SCHUTZ - AUSTREICHEND ANGESICHTS DER BEDROHUNG DER OFFENTLICHEN WASSERVERSORGUNG DURCH GRUNDWASSERVERUNREINIGUNGEN.),
Bonn Univ. (Germany, F.R.). Inst. fuer das Recht der Wasserwirtschaft.
J. Salzwedel.
Gas- und Wasserfach: Wasser-Abwasser, Vol 123, No 11, p 531-539, 1982.

Descriptors: *Water supply, *Water pollution sources, Halogenated hydrocarbons, Nitrates, Sulfates, Fertilizers, Germany, Leaching, Sewer systems, Legal aspects, Legislation, Regulations, Dumping, Groundwater contamination.

Pollution of water supplies in Germany by halogenated hydrocarbons, nitrates and sulfates continues to be a problem. The State regulations concerning requirements for storing, transferring, and transporting water-polluting substances were an important step toward a better groundwater protection system. Leaching of halogenated hydrocarbons through sewage pipes can only be resolved by introducing adequate inhibitions or restrictions into local drainage through laws or law enforcement of the legal instruments provided in some State Water Acts concerning discharges into sewers. Licenses permitting exceptions for dumping sites in water catchment areas should no longer be granted. Disposal of animal excreta and fertilizers in or close to water catchment areas needs a license under the Federal Water Act. Use of such license makes it possible to enforce a fertilizing scheme which will safeguard the protection of the groundwater against nitrates and sulfates. The restrictions on farming in the interest of public water supply safety do not entitle the farmers to compensation. A farmer who causes damage to a water works by polluting the groundwater is required to compensate for the damage, whether or not it is directly his fault. (Baker-FRC)
W83-04093

1982 STOCKHOLM CONFERENCE ON ACIDIFICATION OF THE ENVIRONMENT,
B. Hileman.
Environmental Science & Technology, Vol 17, No 1, p 15A-18A, January, 1983.

Descriptors: *Fate of pollutants, *Water pollution effects. *Air pollution, *Acid rain, *Conferences, Water pollution sources, Sulfur compounds, Regulations, Oxides, Nitrogen compounds, International agreements.

Recently West Germany and Switzerland took up the position of the Scandinavian countries in viewing acid rain as a problem which should warrant control actions. The problem of forest destruction by acid rain was discussed intensively at the 1982 Stockholm Conference on Acidification of the Environment. The conference consisted of three international meetings. The first was on the ecological effects of acid deposition, and the second was on methods to control sulfur and nitrogen oxide emissions. The third conference was a ministerial meeting of government representatives. The first two expert conferences concluded that forest damage in an estimated one million hectares of Central Europe seems to be related to gaseous pollutants and soil impoverishment, and that trees will not survive beyond 30 to 50 years of age. The United States and Great Britain were the only two countries that contended immediate reductions in sulfur dioxide and nitrogen oxide emissions were not in order until more research is performed. The ministers' conference adopted a consensus statement asserting that further concrete action is needed to control trans-boundary air pollution and called for concerted international programs for the reduction of sulfur emissions. The consensus statement, however, is nonbinding, and did not receive the support of all polluting nations. (Geiger-FRC)
W83-04095

CONTINENTAL-SCALE VARIATIONS IN PRECIPITATION CHEMISTRY,
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 2K.
W83-04096

ASBESTOS POLLUTION LEVELS IN RIVER WATER MEASURED BY PROTON-INDUCED X-RAY EMISSION (PIXE) TECHNIQUES,
Montreal Univ. (Quebec). Lab. de Physique Nucleaire.
S. Monaro, S. Landsberger, R. Lecomte, and P. Paradis.
Environmental Pollution, Series B, Vol 5, No 2, p 83-90, 1983. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Asbestos, *Magnesium, *Mine wastes, Fate of pollutants, Water analysis, Quebec, Rivers, Becancour River, X-ray emission techniques.

Asbestos fiber levels were determined by proton-induced X-ray emission (PIXE) at 12 sites in the Becancour River, Quebec, which drains the mining areas of Thetford Mines and Black Lake. Of the 13 elements determined, Mg was most highly correlated with the number of asbestos fibers as determined by transmission electron microscopy. About 1.25 billion fibers per liter correlated with about 250 micrograms Mg per liter; about 5 billion fibers per liter, with 1500 micrograms Mg per liter. Highest Mg concentrations were found within the mining area and reached 2500 micrograms Mg per liter during a rainstorm. The average of dry weather samples reached a maximum of about 800 micrograms Mg per liter. Mg concentrations decreased sharply to 100 micrograms per liter within a few km downstream from the mining area as a result of sedimentation in lakes. (Cassar-FRC)
W83-04097

RELEASE OF POLYCHLORINATED BIPHENYLS FROM CONTAMINATED LAKE SEDIMENTS: FLUX AND APPARENT DIFFUSIVITIES OF FOUR INDIVIDUAL PCBS,
Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences.
J. B. Fisher, R. L. Petty, and W. Lick.
Environmental Pollution, Series b, Vol 5, No 2, p 121-132, 1983. 3 Fig, 3 Tab, 31 Ref.

Descriptors: *Polychlorinated biphenyls, *Sediments, *Desorption, Fate of pollutants, Chlorinated hydrocarbons, Organic compounds, Diffusivity, Waukegan Harbor, Illinois.

The release of polychlorinated biphenyls (PCB) from contaminated Great Lakes sediments to overlying water was studied in the laboratory. Sediments, obtained from Waukegan Harbor, contained (in nmol per g dry sediment): 2,3,5-trichlorobiphenyl, 3.6; 2,2,4,5-tetrachorobiphenyl, 5.7; 2,2,4,5,5-pentachlorobiphenyl, 1.3; and 2,2,3,4,5-pentachlorobiphenyl, 0.59. Fluxes from sediment to water (0.02-1.58 nmol per sq m per day) measured during 4 collection periods (Days 4-12, 12-25, 25-28.9, and 48.9-73.8) were largest during the first period and decreased with time. The most mobile was 2,2,4,5,5-pentachlorobiphenyl, followed in decreasing order by the tetrachloro-; the 2,2,3,4,5-pentachloro-; and the trichlor- compounds. Apparent diffusivities were 1.2-850 times 10 to the minus 9 power sq cm per day. In the absence of disturbance and with low sedimentation rates, PCB in a surface layer will be covered over and removed from access to overlying water within 3 years. (Cassar-FRC)
W83-04098

MERCURY SPECIATION IN WATER,
Alberta Environmental Center, Vegreville.
S. Ramamoorthy, T. C. Cheng, and D. J. Kushner.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 40, No 1, p 85-89, 1983. 4 Fig, 12 Ref.

Descriptors: *Mercury, *Speciation, *Water, Air, Bacteria, Hydrogen peroxide, Path of pollutants, Fate of pollutants.

Mercury speciation was investigated in water and in the air above water surfaces. The effects of hydrogen peroxide, of bacterial growth medium which contains a number of mercury binding compounds, and of both living and dead bacteria were also tested. Metallic mercury is transported from water into the air by both living and dead bacteria. The amount of total mercury produced in the head space was similar in living or dead bacterial and hydrogen peroxide systems. Hydrogen peroxide stabilized mercury in the system. Partition coefficients were calculated from the corrected concentrations in the head space using literature solubility values for air/water phases. It is possible that metallic mercury could be produced in a microenvironment through biological or abiological pathways, and further movements to air from the water or subsequent transformation of this mercury will depend on the physicochemical conditions of the bulk water. (Baker-FRC)
W83-04105

THE REGIONAL SEAS PROGRAM: WHAT FATE FOR UNEP'S CROWN JEWELS.,
P. Hulm.
Ambio, Vol 12, No 1, p 2-13, 1982. 10 Fig, 25 Ref.

Descriptors: *Water pollution control, Seawater, Atlantic Ocean, Pacific Ocean, Asian Ocean, Caribbean Sea, Red Sea, Gulf of Aden, Kuwait, Mediterranean Sea, Water management, Administration, Planning, International waters, International commissions, International agreements.

An overview is offered of each of UNEP's 10 Regional Seas Programs. In the area of the Mediterranean Sea the main pollution problems in coastal waters are caused by domestic sewage and industrial discharges, the use of pesticides in agriculture, and oil pollution from heavy ship traffic. In the Red Sea and Gulf of Aden problems arise from accidental spills and intentional discharges by ships, oil from land based sources, physical disturbances resulting from dredging, and construction operations. In the Kuwait region, eight of the fastest developing countries in the world cluster around the Gulf, but it gets virtually no rain and hardly any freshwater except through the Shatt al-Arab. Urban growth has outstripped facilities for sewage and garbage disposal. Wastes from booming industrial developments are fast becoming a major concern. The largest single source of marine pollution has been the giant oil tankers. In the

Wider Caribbean area of two of the most important ecosystems are the coral reefs and the mangrove swamps. Coral reefs are menaced by collectors, careless boaters, siltation, and chemical runoff from agricultural pesticides and fertilizers. Mangrove swamps are threatened with deliberate destruction as people build marinas, beaches and hotels. In west and central Africa problems include oil pollution, discharges from developing industries, wastes from inland sources such as sewage, and agricultural runoff. East Asia's most pressing problems are oil pollution from offshore and onshore activities and from tanker traffic, coral reef destruction from blast fishing, destruction of mangrove swamps by fish pond operators and logger, and sewage pollution in shell-fishing areas. Southeast Pacific areas are threatened by mineral pollution, food processing wastes and oil pollution. Southwest Pacific regions are concerned with management of limited resources, both terrestial and marine. East Africa deals with heavy oil tanker traffic and preservation of the mangrove animal life. Southwest Atlantic regions are just getting underway with pollution control studies. (Baker-FRC)
W83-04131

LIMNOLOGY OF LAHONTAN RESERVOIR, 1980-1982,
Nevada Univ. System, Reno. Bioresources Center.
J. J. Cooper, S. C. Vigg, R. W. Bryce, and R. L. Jacobson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105428, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Center, Desert Research Institute Publication No 50020, September 1983. 187 p, 40 Tab, 49 Fig, 170 Ref. OWRT B-117-NEV(1), 14-34-0001-0271.

Descriptors: Water quality management, Water quality, Limnology, *Chlorophyll a, *Nitrogen, *Phosphorus, *Algal toxins, *Eutrophication, Phytoplankton, Zooplankton, Lake sediments, *Nevada, Lahontan Reservoir, Mercury, Arsenic, Lead, Iron.

Based on the level of primary production, chlorophyll a concentration and the dominance of the alga Aphanizomenon flos-aquae, Lahontan Reservoir can be categorized as a eutrophic waterbody. Probably the most important environmental factor contributing to the dominance of this blue-green alga is Lahontan's low N:P ratio. Phosphorus removal from loading is the best technique for eutrophication abatement, and nitrogen removal may be detrimental because it could encourage the growth of nitrogen fixing blue-green algae. The major sources of phosphorus are the Carson River and Truckee canal with the sediments acting as a net phosphorus sink. Bank storage return to the reservoir during low stages may be another source of phosphorus. The measured phosphorus from under water seepage and bank flow are TP up to 12.9 mg/l and OP up to 1.0 mg/l. Mercury in the sediments is a problem because the elevated levels have permitted some transfer to the food chain. At the present time numerous fish species are at or slightly above the recommended Hg levels. Arsenic and lead are also detected in the sediments but do not appear to present a problem at this time. Iron concentrations are high which is expected and probably accounts for most of the phosphorus adsorption.
W83-04144

PHYTOPLANKTON UPTAKE AND SEDIMENT RELEASE OF NITROGEN AND PHOSPHORUS IN THE CHOWAN RIVER, NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5C.
W83-04146

POLYCYCLIC AROMATIC HYDROCARBONS-ARE THEY A PROBLEM IN PROCESSED OIL SHALES,
Utah Water Research Lab., Logan.
D. L. Maase, and V. D. Adams.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105469, Price codes: A08 in paper copy, A01 in microfiche. Water Quality Series UWRL/Q-83/07, May 1983. 160 p, 16 Fig, 34 Tab, 254 Ref, 3 Append. OWRT B-154-UTAH(2), 14-34-0001-8123.

Descriptors: Oil shale, Hydrocarbons, Chlorination, Wastewater treatment, Carcinogens, Drinking water, *Environmental effects, Organic wastes, Organic carbon, *Polycyclic aromatic hydrocarbons, *Aromatic hydrocarbons, Water treatment.

Development of an oil shale industry could potentially expose spent shales to the natural elements and thereby introduce polycyclic aromatic hydrocarbons (PAH) into the environment where they may enter rivers and lakes and eventually public water supplies. In the first case, harms to the aquatic environment are possible. In the second, chlorine disinfection may convert some of these hydrocarbons into carcinogenic compounds. Analysis of the problem requires assessment of the amount of source material and its fate and potency. In order to estimate the potential PAH flux, a probable development scenario for exposure of processed oil shale in surface disposal sites in the White River Basin of Utah and Colorado was projected along with influential hydrologic and geologic parameters. Processed oil shale samples were obtained from the Union B, Paraho, and Tosco II processes, and samples were extracted by organic solvents in a soxhlet apparatus and by mixing shale samples with water. The organic chemistry literature was used to identify hydrocarbon regimes and classify 3 through 6 ring aromatic hydrocarbons in a tabular format. More than 100 organic compounds from processed oil shales were identified by gas chromatography and mass spectrometry. Four and 5 ring PAH were found to be benzene extractable from processed shales in concentrations ranging up to 50 ppb. Sediment transport or eroded shale is an equally important potential shale source. Chlorine disinfection studies indicate that chlorination does not protect well buffered drinking water supplies from PAH-originating carcinogens. As to the threat to the natural environment, the PAH are believed to gradually degrade to smaller PAH and finally to aliphatic acid. Research on the processes and environmental effects at all stages need to be pursued.
W83-04148

CONCENTRATIONS OF ORGANIC PHOSPHATE, NITROGEN, AND CARBON IN STORM RUNOFF AND COMBINED SEWERS IN THE GREATER WASHINGTON, D.C. AREA,
American Univ., Washington, DC. Dept. of Biology.
M. A. Champ.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105576, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Report No 54, Univ. of the District of Columbia, Washington, D.C., September 1983. 49 p, 6 Fig, 7 Tab, 34 Ref, 1 Append. OWRT A-004-DC(1), 14-31-001-50502.

Descriptors: *Organic phosphate, *Nitrogen, *Dissolved organic carbon, Combined sewer, *Street runoff samples, Shopping center parking lot, Rock Creek, Potomac River, Nutrients, River estuary, *District of Columbia, *Storm sewer runoff.

Concentrations of organic phosphate, nitrogen, and carbon have been determined in storm and combined sewers, sanitary sewers, street runoff, shopping center parking lot runoff, residential and industrial areas, and Rock Creek to determine their range of variation and relative magnitude. Combined sewers exhibit tremendous variation in organic carbon, and nitrogen concentrations. Estimates of the nutrient loads by major sources (storm sewers, combined sewer over flows, etc.) to the upper Potomac River Estuary for 1977 indicate that during a low flow year, combined sewer overflow contributes an insignificant amount of phosphate, nitrogen and carbon. However, during the same period the storm sewer runoff did contribute high loads of carbon and was a minor source of nitrogen.
W83-04159

POLLUTION EFFECTS ON ECOBIOLOGY OF BENTHIC POLYCHAETES IN VISAKHAPATNAM HARBOUR (BAY OF BENGAL),
Andhra Univ., Waltair (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W83-04165

METAL AND BACTERIAL CONTAMINATION IN NEW JERSEY ESTUARINE SEDIMENTS,
Quebec Univ., Rimouski. Dept. of Oceanography.
W. H. Renwick, and H. M. Edenborn.
Environmental Pollution, Series B, Vol 5, No 3, p 175-185, 1983. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Heavy metals, *Coliforms, *Water pollution sources, *Estuaries, *Marine sediments, *Streptococcus, Urban runoff, Metals, Fate of pollutants, Enteric bacteria, Bays, Lagoons, *New Jersey.

Metal and bacterial contamination was examined in sediments of 24 channels of New Jersey lagoons or back bays scheduled for maintenance dredging. Seventy samples were analyzed for texture, total coliforms (TC), fecal coliforms (FC), fecal streptococci (FS), and seven heavy metals. Bacterial analyses revealed TC, FC, and FS concentrations as high as 8334, 3052, and 3052 most probable number units/g dry weight, respectively. Sediment metal levels were moderate compared with those of estuaries in urban areas and were higher in more populated northern areas. Enrichment factors ranged from 1 to 50 times probable background levels. TC and metal levels were negatively correlated with percentage of sand in the samples. FC and FS were poorly correlated with texture, suggesting localized sources for these bacteria. The intercorrelations of metal levels suggested discrete and common sources for these contaminants. TC and metal levels were highest in densely populated areas, suggesting that urban runoff may be a major pollution source. The concentrations of pollutants in the heavily contaminated areas are high enough to warrant additional studies prior to dredging and soil disposal. (Geiger-FRC)
W83-04171

HEAVY METALS IN THE SEDIMENTS OF COCKBURN SOUND, WESTERN AUSTRALIA, AND ITS SURROUNDING AREAS,
Envirochem, Perth (Australia).
V. Talbot, and A. Chegwidden.
Environmental Pollution, Series B, Vol 5, No 3, p 187-205, 1983. 1 Fig, 2 Tab, 34 Ref.

Descriptors: *Heavy metals, *Water pollution sources, *Fate of pollutants, *Marine sediments, *Cadmium, *Indicators, Industrial wastes, Metals, Hydrogen ion concentration, Conductivity, Chromium, Lead, Cockburn Sound, *Australia.

The extensive industrial development of Western Australia near Cockburn Sound has prompted studies of some physical properties (conductivity and pH), heavy metal levels, and organic and carbonate levels of the calcareous marine sediments of this area. Regional and local surveys and core and surface sediment samplings showed no evidence of the widespread cadmium (Cd) pollution that is known to exist in the biota due to discharges of Cd-contaminated gypsum. However, lead was concentrated in the carbonate sediments, and chromium (Cr) from tannery wastes was also found. Although the concentrations of metals in sediments correlated significantly with the anthropogenic activities around the Sound, the overall use of marine calcareous sediments as indicators of heavy metal pollution is not recommended when oxidizing conditions prevail. (Geiger-FRC)
W83-04173

THE DEPAUPERATION OF EPIFAUNA ON PINNA BICOLOR NEAR A LEAD SMELTER, SPENCER GULF, SOUTH AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Cronulla (Australia). Div. of Fisheries Research.
For primary bibliographic entry see Field 5C.
W83-04174

CONTINUED STUDIES OF ACID RAIN AND ITS EFFECTS ON THE BATON ROUGE AREA,
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
J. W. Robinson, and H. Ghane.
Journal of Environmental Science and Health, Part A, Vol 18, No 2, p 165-174, 1983. 7 Fig, 1 Tab, 7 Ref.

Descriptors: *Baton Rouge, *Louisiana, *Dissolved oxygen, *Hydrogen ion concentration, *Acid rain, *Lakes, Water pollution effects, Fate of pollutants, Acidic water, Ecological effects, Water pollution sources, Monitoring, Path of pollutants.

In an ongoing project to study the effects of acid rain in the Baton Rouge area, two lakes were monitored for dissolved oxygen, pH, and buffering capacity before and after rainfall from 1981 to 1982. The smaller of the two lakes revealed higher pH than the larger and exhibited a higher buffering capacity. The pH of the lakes was lower in 1982 compared to 1981, and dissolved oxygen levels increased after rainfalls. The effects of dredging of the larger lake on parameters studied were inconclusive. Although a pH of less than 5 is generally undesirable for aquatic life, the sensitivity of this threshold value depends on such factors as watershed size and amount of precipitation. Due to the relatively large watershed and high total acid deposition in the Baton Rouge area, these lakes are susceptible to reductions in buffering capacity which would be undesirable to aquatic life. Future monitoring programs of this problem will include data collections on pH, wind direction, dissolved oxygen levels, and major anions and cations in rain water. (Geiger-FRC)
W83-04186

A NOTE ON THE GROWTH OF THIOTHRIX IN ROAD DRAINAGE DITCHES,
Freshwater Biological Association, Ambleside (England).
J. G. Jones, F. M. S. Jay, and J. Hilton.
Journal of Applied Bacteriology, Vol 53, No 3, p 427-430, 1982. 1 Fig, 3 Tab, 5 Ref.

Descriptors: *Thiobacillus, Road construction, *Fate of pollutants, Water pollution sources, Drainage effects, *Sulfur, *Bacterial analysis, *Lake sediments, Drainage ditches, Water pollution effects, Sulfides, Hydrogen ion concentration, Path of pollutants, Bioindicators, Limestone, *England, Bassenthwaite Lake.

Macroscopic growth of Thiothrix has been noted in ditches draining new sections of the A66 road along the Bassenthwaite Lake of the English Lake District. Furnace slag and limestone had been used as hard core during road construction. The growth of Thiothrix resembled the sewage complex found in polluted rivers. Of the eight ditch sites studied, Thiothrix was not observed in two, possibly due to high sulfide levels of pH and total ions in one ditch and low oxygen levels and high conductivity and pH in the other. Studies to determine the effects of ditch contamination on the lake revealed little evidence of adverse effects. Enrichment by sulfur was confined to sites closest to the mouth of Wythop Beck, and bacteria which usually develop in sulfide-rich sediments were not detected. The development of Thiothrix populations may serve as a useful indicator of sulfide contamination and contribute to the detoxification of the drainage water without imposing a significant oxygen demand. (Geiger-FRC)
W83-04199

5C. Effects Of Pollution

HEPATIC METALLOTHIONEIN IN RAINBOW TROUT (SALMO GAIRDNERI) AS AN INDICATOR OF METAL POLLUTION IN THE CAMPBELL RIVER SYSTEM,
Victoria Univ. (British Columbia). Dept. of Biochemistry and Microbiology.
M. Roch, J. A. McCarter, A. T. Matheson, M. J. R. Clark, and R. W. Olafson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 12, p 1596-1601, December, 1982. 3 Fig, 3 Tab, 23 Ref.

Descriptors: Fish, *Accumulation, Metals, *Metallothionein, Proteins, Pollutant identification, Bioaccumulation, Fate of pollutants, Campbell River, *British Columbia, Trout, Zinc, Copper, Cadmium, *Heavy metals, Mine wastes, *Rainbow trout.

Levels of hepatic metallothionein in rainbow trout livers reflected the exposure of the fish to heavy metals in the Campbell River system, British Columbia, which is contaminated with zinc and other metals derived from mine tailings. Concentrations of metals in water samples were of the order Zn>Cu>Cd; in fish livers, Cu>Zn>Cd. Highest metals concentrations in fish livers were found in South Buttle Lake, nearest the mine: 539 + or - 124 micrograms per g Cu; 168 + or - 50 micrograms per g Zn; and 19.4 + or - 6.1 micrograms per g Cd. Metallothionein concentrations increased from 58 + or - 14 nmol per g in livers from fish taken in an unpolluted lake to 269 + or - 23 nmol per g in livers from fish taken from the most heavily contaminated site, South Buttle Lake. (Cassar-FRC)
W83-03854

A STUDY ON THE EVALUATION OF WATER QUALITY WITH RESPECT TO BORON FOR WHEAT AND BARLEY GROWTH ON LOAMY SAND SOIL,
S.K.N. Coll. of Agriculture, Jobner (India).
F. Lal, and P. Lal.
Annals of Arid Zone, Vol 19, No 3, p 239-241, September, 1980. 2 Tab, 8 Ref.

Descriptors: *Boron, *Irrigation water, *Crop yield, Water pollution effects, Toxicity, Wheat, Barley, Water quality.

Wheat and barley were grown on alkaline loamy sand soils on an experimental farm in India using irrigation waters with boron levels of 0.7, 1.7, 2.7, 4.7, 6.7, and 8.7 ppm, pH of 8.8, electric conductivity of 2.1 mmhos per cm, sodium absorption ratio of 23.7, and residual sodium carbonate of 14.2 meq per liter. The soil was low in boron. Grain and straw yields of wheat increased significantly up to 1.7 ppm boron in water and gradually decreased thereafter. At 8.7 ppm boron the wheat yield was reduced by 30% of the maximum yield. Data on barley were similar, except that the maximum yields were obtained at a boron concentration of 2.7 ppm. Apparently the accumulated boron was leached out by successive irrigations in this soil, permitting crops to be grown safely at boron concentrations higher than the usually accepted 2 ppm. (Cassar-FRC)
W83-03870

THE INFLUENCE OF PREVIOUS LIGHT HISTORY ON THE RESPIRATION OF FOUR SPECIES OF FRESHWATER PHYTOPLANKTON,
Adelaide Univ. (Australia). Dept. of Botany.
S. Stone, and G. Ganf.
Archiv fur Hydrobiologie, Vol 91, No 4, p 435-462, July, 1981. 12 Fig, 3 Tab, 44 Ref.

Descriptors: *Light intensity, *Phytoplankton, *Respiration, *Irradiation, *Euthrophication, Euphotic zone, Regression analysis, Cyanophyta, Photosynthesis, Chlorophyta, Oxygen requirements, Oxygen uptake, Radiation, Hysteresis, Model studies, Mathematical studies, Light penetration.

The separate effects of light intensity and duration on the respiration of Microcystis aeruginosa, Anabaena cylindrica, Secenedesmus quadricauda and Pedisastrum boryanum were investigated by an oxygen electrode technique. As light intensity increased, all species showed a general increase in respiration Secenedesmus, Pediastrum and Anabaena exhibited a strong correlation between respiration and photosynthetic rate, while Micorocystic had respriatory rates which increased at irradiances above photosynthetic light saturation. After prolonged illumination, rates of dark respiration were increased for up to 14 hr. The initial decline in respiration was decribed by a negative exponential function. Regression analysis utilizing the respiratory coefficient was used to estimate the critical downward velocity throught the euphotic zone needed to elicit a hysteresis effect. Due to their greater critical downward velocity, green algae seemed better adapted to rapid circulation than blue-green algae. Dark respiration rates were greatest in Anabaena and Microcystis. This was attributed to their ability to maintain their position in the euphotic zone, which reduced their need to conserve photosythate. (Geiger-FRC)
W83-03874

CARBON-14 ASSIMILATION BY ALGAL COMMUNITIES OF OLIGOTHROPHIC PONDS TREATED WITH FORMULATED AMINOCARB,
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
J. K. Elner, D. J. Wildish, and D. W. Johnston.
Archives of Environmental Contamination and Toxicology, Vol 11, No 6, p 675-679, November, 1982. 5 Fig, 2 Tab, 15 Ref.

Descriptors: *Pesticides, *Algae, *Toxicity, Aminocarb, Matacil, Oligothrophic lakes, Water pollution effects, Ponds, Inhibition, *New Brunswick.

The effects of an animocarb formulation (Matacil 1.8D) on algal communities were studied in a natural pond in New Brunswick. The insecticide, used in forests for controlling spruce budworm, was composed of 21.7% aminocarb, 51.2% nonly phenol (formerly found capable of cellular disruption in flagellates), and 17.1% No. 585 oil. Carbon-14 assimilation was used to measure algal production. Unsolubilized Matacil at a concentration of 1454.4 ppm aminocarb reduced carbon uptake to 24.5% of its original value after 5 hours of incubation. During a 28-hour carbon uptake was reduced to 20% of the initial value at 1.45-14.5 ppm aminocarb and to about 7% at 1454.4 ppm. Using ethanol-solubilized Matacil to increase solubility, carbon assimilation was virtually stopped at 1-2 ppm for both incubation periods. EC50 values were 0.88 ppm and 0.56 ppm for the 5 and 28-hour incubation periods, respectively. In another experiment in EC50 of 0.94 ppm of solubilized Matacil was obtained in a 4-hour incubation; all algal carbon assimilation had ceased by 1.54 ppm. At insecticide concentrations up to 2.24 ppm aminocarb or less, algal production recovered within 72 hours. Maximum aminocarb levels in water affected by forest spraying are 0.02 ppm. Although all insecticide levels were reported as ppm aminocarb, other components of the formulation may also affect toxicity. (Cassar-FRC)
W83-03876

EFFECTS OF THE WATER-SOLUBLE FRACTION OF A COAL-DERIVED OIL ON POND MICROCOSMS,
Oak Ridge National Lab., TN.
J. M. Giddings.
Archives of Environmental Contamination and Toxicology, Vol 11, No 6, p 735-747, November, 1982. 12 Fig, 4 Tab, 22 Ref.

Descriptors: *Coal liquefaction, *Oil wastes, *Aquatic life, *Water pollution effects, Ecosystems, Algae, Macrophytes, Aquatic plants, Snails, Zooplankton, Diatoms, Toxicity, Water quality, Species composition, Synthetic fuels, Phytoplankton.

The effects of a solution of the water-soluble fraction (98% phenols by weight) of a crude coal liquefaction product on 80-liter pond microcosms were studied for 9 weeks. The oil, produced by the Solvent Refined Coal-II Process in a pilot plant, was a blend of middle and heavy distillates. The 1% dose applied to the aquariums was close to the 48-hour LC50 for Daphnia magna and for photosynthetic inhibition of algae. In the first 5 days after treatment much of the Elodea turned brown, Nitella survived, and Spirogyra turned pale and sank. Snails crawled out of the tank. Zooplankton became scarce. Primary production and respiration declined for two weeks, remained low for two

more weeks, and gradually returned to pretreatment levels. Changes occurred in pH, alkalinity, conductivity, dissolved oxygen, dissolved organic carbon, and dissolved inorganic nitrogen. After several weeks of nearly anaerobic conditions the ecosystems started to recover. By the end of the experiment the communities were different in composition. Spirogyra had not returned, and Nitella had increased in abundance. A small unidentified claderoceran replaced Simocephalus as the major zooplankton species. Ostracods and oligochaetes increased in numbers. Community compositions of benthic algae were radically changed by the treatment and were different in the two replicates. At the end of the experiment snail biomass and macrophyte biomass averaged 66% and 28%, respectively, of that in controls. (Cassar-FRC)
W83-03877

COMPARISON OF ESTUARINE SPECIES SENSITIVITIES TO THREE TOXICANTS,
William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
M. H. Roberts, J. E. Warinner, Jr., C.-F. Tsai, D. Wright, and L. E. Cronin.
Archives of Environmental Contamination and Toxicology, Vol 11, No 6, p 681-692, November, 1982. 6 Fig, 4 Tab, 34 Ref.

Descriptors: *Toxicity, *Phytoplankton, Aquatic animals, *Bioindicators, *Water pollution effects, Estuarine environment, Sodium lauryl sulfate, Detergents, Cadmium, Lannate, Methomyl, Insecticides, Pesticides, Copepods, Invertebrates, Fish, Algae, Shrimp.

Tests were conducted to compare the sensitivity of EPA standard species with that of species more representative of the Chesapeake Bay. The acute toxic effects of sodium lauryl sulfate (SLS), cadmium, and Lannate (24% methomyl in ethanol) were tested on species pairs, which included phytoplankton (Prorocentrum minimum, Pseudoisochrysis paradoxa, Skeletonema costatum); mysid shrimp (Neomysis americana and Mysodopsis bahia); copepods (Eurytemora affinis and Acartia tonsa); and fish (Menidia menidia and Cyprinodon variegatus). The EC50s (mg per liter) for phytoplankton were: SLS, 1.27-2.33; cadmium, 12-681; and Lannate, 388-580. The 96 hour LC50s (mg per liter) for the animals were: mysids, 5.7-8.8 for SLS, 0.017-0.036 for Cd, and 0.030-0.064 for Lannate; copepods, 0.55-2.6 for SL, 0.06-0.38 for Cd, and 0.29-0.41 for Lannate; fish, 2.8-4.1 fo SLS, 6.4-15.9 for Cd, and 0.34-0.96 for Lannate. All EC and LC50s within a species group were similar except for phytoplankton response to Cd. (Cassar-FRC)
W83-03878

PLANKTON OF THE LOWER RIVER MURRAY, SOUTH AUSTRALIA,
Adelaide Univ. (Australia). Dept. of Zoology.
R. J. Shiel, K. F. Walker, and W. D. Williams.
Australian Journal of Marine and Freshwater Research, Vol 33, No 2, p 301-327, 1982. 11 Fig, 3 Tab, 57 Ref.

Descriptors: *Seasonal variation, *Zooplankton, *Phytoplankton, Murray River, Darling River, *Australia, Plankton, Algae, Diatoms, Cyanophyta, Species composition, Rivers, Semiarid lands, Eutrophication, Rotifers, Regulated flow, Littoral zone, Temperature effects, Salinity, Turbidity.

Seasonal variations in plankton composition of the Murray River, Australia, were investigated during 1976-77. Flows in the 2500 km long Murray were variable, exceptionally slow, and regulated by many weirs and reservoirs. Its major tributary, the 2700 km Darling River, has a small, variable flow, is relatively unregulated, and has a deeply incised floodplain. The Darling enters the Murray about 500 km upstream from the sea. Murray waters carry blooms of Cyanobacteria (Anabaena and Anacystis spp.) in summer and diatoms (Melosira and Cyclotella spp.) in winter and spring. Murray zooplankton comprised 133 taxa: 87 Rotifera, 31 Cladocera, 13 Copepoda, and 2 Ostracoda. More than half were pseudoplanktonic or from the littoral zone. More than half were endemic. Most were derived from upstream reservoirs. Mean zooplankton density at a station 150 km from the Murray mouth measured 119 individuals per liter. Most species were indicative of eutrophic conditions. Darling waters had high turbidity, low algal biomass, and zooplankton dominated by rotifers of the warm stenothermal pantropical type. The composition of the lower Murray plankton depended on the flow contributions of the 2 rivers. Darling contributions were indentifiable by the tropical plankton. Temperature, salinity, and turbidity also affected the lower river species composition. (Cassar-FRC)
W83-03892

ASSESSMENT OF ACIDITY OF LAKES AND PRECIPITATION IN THE SIERRA NEVADA,
California Univ., Santa Barbara. Marine Science Inst.
For primary bibliographic entry see Field 5B.
W83-03911

SURVIVAL AND GROWTH OF WARMWATER FISHES EXPOSED TO AMMONIA UNDER LOW FLOW CONDITIONS,
J. P. Swigert, and A. Spacie.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-257535, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 157, June 1983. 83 p, 3 Fig, 13 Tab, 33 Ref, 1 Append. OWRT B-115-IND(1).

Descriptors: *Fish, *Toxicity, *Ammonia, Growth, Survival, Fathead minnows, *Indiana, Low flow, Ammonium chloride, Water pollution effects, *Dissolved oxygen, Lethal limit.

The acute toxicity of ammonium chloride was measured for eight fish species representing four families commonly found in midwestern streams. A positive linear relationship was found between the 96-hour median lethal concentrations (LC50) for low dissolved oxygen, and the ambient concentration of ammonia in 96-hour exposures with fathead minnows. Proportional mortality could be described as a linear function of dissolved oxygen concentration and on interaction term between oxygen and ammonia. The results were also shown to follow a concentration-addition model for joint toxic action when ammonia and oxygen concentrations were expressed as 'toxic units'. For 16 families occurring in midwestern non-salmonid waters, a value of 0.2 mg NH sub 3-N/1 was obtained as the criterion maximum (concentration not to be exceeded). The maximum allowable 30-day average concentration was found to be 0.04 mg NH sub 3-N/1. Allowable discharge rates based on 30-day average conditions are more restrictive than discharges based on a one-day maximum allowable concentration for 11 Indiana streams examined.
W83-03923

LETHAL AND SUBLETHAL EXPOSURE AND RECOVERY EFFECTS OF OZONE-PRODUCED OXIDANTS ON ADULT WHITE PERCH (MORONE AMERICANA GMELIN),
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
L. B. Richardson, D. T. Burton, R. M. Block, and A. M. Stavola.
Water Research, Vol 17, No 2, p 205-203, February, 1983. 4 Fig, 1 Tab, 43 Ref.

Descriptors: *Ozonation, *Toxicity, *Sublethal effects, Fish Toxins, Perch, Ozone, Tissue analysis, Gills, Water treatment, Oxidation-reduction potential, Fish, Laboratory studies, Water pollution effects.

Adult white perch (Morone americana), acclimated to 15C, were exposed to a series of ozone-produced oxidants (OPO) concentrations for 96 hours using continuous flow bioassay techniques. Blood pH, hematocrit, and gill histopathology were analyzed in perch exposed to a series of near-lethal and sublethal OPO concentrations at 24, 48, and 96 hours and after 4 and 14 days in the recovery period, which they spent in clean, non-ozonated water. The 24-, 48-, and 96-hour LC-50's were 0.38, 0.26, and 0.20 milligrams OPO per liter, respectively. Significant reductions of blood pH occurred at concentrations of at least 0.15 milligrams OPO per liter, but not at 0.10 milligrams OPO per liter or lower. Hematocrit significantly increased at concentrations of 0.10 milligrams OPO per liter or greater. OPO concentrations of 0.01 milligrams per liter had minimal effects on gill tissue, while moderate epithelial sloughing and heavy mucus production occurred at 0.05 milligrams OPO per liter, and extreme tissue damage was found at concentrations of at least 0.10 milligrams OPO per liter. These results demonstrate the OPO causes death by destroying the gill tissue and thus the respiratory and osmoregulatory capabilities of a fish, eventually causing death through internal hypoxia. When blood pH has been reduced by more than about 0.3 units, gill tissue damage is too extensive for recovery and the fish will eventually die. If gill damage is moderate, white perch gill epithelium can repair itself within 4 days. Comparison of these test results with previous reports of the effects of chlorine produced oxidants shows that the toxicities of these oxidants to adult white perch are about equal when tested under similar conditions and that both have similar effects on gill tissue. (Carroll-FRC)
W83-03932

RE-USE OF SLUDGES AND TREATED WASTE WATER IN AGRICULTURE. (TROUBLES ARISING FROM THE CONTAMINATION OF SOILS WITH HEAVY METALS AND FROM APPLICATION OF SLUDGES AND TREATED WASTE WATER IN AGRICULTURE),
Biologische Bundesanstalt fuer Land- und Forstwirtschaft, Berlin (Germany, F.R.). Inst. for Non-Parasitic Plant Diseases.
For primary bibliographic entry see Field 5E.
W83-03970

HEALTH RISKS ASSOCIATED WITH WATER RECYCLING,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 3C.
W83-03971

PLANT AND SOIL REACTIONS TO NICKEL ORE PROCESSED TAILINGS,
Oregon State Univ., Corvallis. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W83-03976

RELATIONSHIP BETWEEN DRINKING WATER QUALITY AND DEATH FROM CARDIOVASUCLAR DISEASE. III. ASSOCIATION BETWEEN HARDNESS AND CHEMICAL CONSTITUENTS OF DRINKING WATER (CORRELAZIONE EPIDEMIOLOGICA TRA QUALITA' DELLE ACQUE POTABILIE MORTALITA' PER MALATTIE DEL SISTEMA CIRCOLATORIO. III. RAPPORTO TRA DUREZZA E I DIFFERENTI COMPONENTI DELLE ACQUE CONDOTTATE),
Perugia Univ. (Italy). Cattedra di Igiene.
G. Scassellati Sforzolini, P. Damiani, R. Pasquini, R. Conti, and G. Burini.
L'Igiene Moderna, Vol 76, No 6, p 1190-1200, December, 1981. 2 Tab, 25 Ref.

Descriptors: *Water analysis, Chemical properties, *Human diseases, Cardiovascular disease, Hardness, Minerals, Chemical composition, Epidemiology, *Public health, *Italy.

The possible association between hardness and different chemical constituents of tap waters was investigated. For 90 groundwater samples from various areas of the Italian Region of Unbria with degrees of hardness varying from 2.3 to 64.2 degrees fr, the total noncarbonate and carbonate hardness, chloride and sulfate levels as well as the concentrations of 16 important cations were determined. Total hardness was correlated positively and fairly strongly with Ca, Mg, Na, Ag, Hg, Pb, Cd, Mn, Cr, Co, C1(-) and So4(2-) content and carbonate hardness and negatively, but rather weakly, with K, Li, and Fe. Carbonate hardness

and negatively, but rather weakly, with K, Li, and Fe. Carbonate hardness correlated positively and fairly strongly with Ca, Mg, Na, Cu, Ag, Hg, Pb, Cd, Mn, and Co content and negatively, but rather weakly, with K, Li, Cr, and Fe. Non-carbonate hardness, sulfate concentration and chloride ion concentration correlated positively and fairly strongly with Ca, Mg, Ag, Cd, Mn, and Co and negatively but weakly with K and Fe. These results are discussed on the basis of the epidemiological correlations observed by different authors between hardness and trace elements in drinking waters and mortality from cardiovascular disease. (Baker-FRC)
W83-04022

ENVIRONMENTAL EFFECTS ON THE TOXICITY OF METHYL MERCURIC CHLORIDE TO CHLORELLA VULGARIS,
North-Eastern Hill Univ., Shillong (India). Dept. of Botany.
L. C. Rai, and R. Dey.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 4, p 319-327, 1980. 6 Fig, 22 Ref.

Descriptors: *Methyl mercuric chloride, *Algae, *Toxicity, Water pollution effects *Chlorella, Chlorophyll, Growth rates, Survival, Phosphates, Hydrogen ion concentration, Heavy metals, Metals, Calcium, Sublethal effects.

The effect of methyl mercuric chloride (0.01, 0.001, and 0.0001 ppm) on survival, growth, and chlorophyll content of Chlorella vulgaris was studied under varying conditions of pH (4-10) and phosphate and Ca concentrations (5-40 ppm). Chlorella survival for 15 days at different concentrations of methyl mercuric chloride was zero at 0.01 ppm, about 5% at 0.001 ppm, and 53.8% at 0.0001 ppm (the sublethal dose). Growth rates at 0.001 and 0.0001 ppm were nearly that of the control for the first 9 days. Optical densities of the cultures at 15 days were: control, 1.45; 0.0001 ppm, 1.4; and 0.001 ppm, 1.0. Chlorophyll a was more greatly inhibited than chlorophyll b at the sublethal dose. At the sublethal dose growth was maximum at pH 7-8, less at pH 5-6 and 9-10, and greatly inhibited at pH 4. Methyl mercuric chloride toxicity was greatly reduced by addition of phosphate, with maximum growth stimulation at 20 ppm phosphate, and by addition of Ca at levels of 5-20 ppm. (Cassar-FRC)
W83-04049

TOXICITY OF PH, HEAVY METALS AND BISULFITE TO A FRESHWATER GREEN ALGA,
Waterloo Univ. (Ontario). Dept. of Biology.
M. D. Baker, C. I. Mayfield, W. E. Inniss, and P. T. S. Wong.
Chemosphere, Vol 12, No 1, p 35-44, 1983. 4 Fig, 35 Ref.

Descriptors: *Algae, *Organic compounds, *Heavy metals, Water pollution effects, Environmental effects, Mercury, Acidity, Lead, *Bisulfite, Algal growth, Chlorophyta, Ankistrodemus, *Toxicity.

The toxicity of mercury and bisulfite to the organisms of Ankistrodesmus sp. was studied under acidic conditions. The effect of pH was determined by adjusting the pH of Bristol's medium to initial values of 3, 4, 5, 6, and 7 by adding 9.5 or 1 N sulfuric acid and 0.5 or 1 N sodium hydroxide. No growth occurred at pH 3. A lag phase of about 4 days was noted at pH 4 before the onset of growth, while a 2-day lag period was noted at pH 5. No apparent lag phase was noted at pH 6 and 7 and, generally, growth at pH values of 5, 6, and 7 was similar until after about 10 days, wherein growth was slightly higher at pH 6. When the effect of pH and bisulfite on the growth of the alga was examined, bisulfite concentrations of 1, 10, and 100 microg/ml did not affect growth at pH 7. However, at bisulfite concentrations of 100 microg/ml growth was almost completely prevented at pH 5. Lead at concentrations of 1, 5, and 10 microg/ml had only slight inhibitory effects on growth at pH 5 and 7. Mercury was much more toxic to algal growth, especially at pH 5. Mercury concentrations of 1, 5, and 10 microg/ml inhibited algal growth by 81, 100, and 100%, respectively, while at pH 7 the corresponding values were 57, 77, and 100%, respectively. These findings clearly indicate that the algal cells were more sensitive to bisulfite and mercury at low pH. It is concluded that these toxic compounds could also inhibit algal growth and activity in acidic aquatic systems. (Baker-FRC)
W83-04054

A THRESHOLD CONCEPT OF ENVIRONMENTAL POLLUTANTS,
Institute of Hygiene, Gera (German, D.R.). Dept. of Toxicology.
R. Koch.
Chemosphere, Vol 12, No 1, p 17-21, 1983. 1 Tab, 10 Ref.

Descriptors: Water pollution effects, *Toxicity, Chemical reactions, Environmental effects, Public health, Mutagenesis, Carcinogenesis, Teratogenesis, Classification.

At present, toxicological data such as the acute toxicity, toxicokinetics, toxicodynamics in subchronic exposure, carcinogenicity, mutagenicity, and teratogenicity are basic elements in thresholds concepts. However, biochemical and animal experimentations needed to obtain the data are limited for several reasons. Theoretical considerations are needed for establishing a generally usable threshold concept. It is important to distinguish exactly between the terms dose or concentration and exposure as well as to define the meaning of the term 'threshold'. While relationships between structure, physicochemical properties and chemical reactivity as well as biological activity are well known in molecular toxicology, it is important to note that a chemical reaction between an exogenous compound and a biological macromolecule in target tissue, organs or cells is a fundamental aspect of many biological activities and toxicity reactions. The kinetic, thermodynamic and structure-activity relationships imply that a threshold level exists, depending on different chemical structure parameters which govern absorption, distribution, bioconcentration and excretion processes; and the activation energy of a biochemical reaction and the temperature, which govern both the number of reactive molecules and the reaction rates. The application of thermodynamic, kinetic and quantum mechanic regularities as well as structure-activity relationships suggests that the single molecule causing biological effect is an unacceptable concept. (Baker-FRC)
W83-04057

ORGANOHALOGENES AS CARCINOGENS IN DRINKING WATER (ORGANOHALOGENE ALS KARZINOGENE IM TRINKWASSER),
Institute of Hygiene, Gera (German, D.R.).
R. Koch, and K. Strobel.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 5, p 407-420, May, 1980. 1 Fig, 3 Tab, 53 Ref. (No English Summary).

Descriptors: *Halogens, *Drinking water, *Carcinogens, *Literature review, *Risks, Cancer, Epidemiology, Public health, Animal experiments, Organic compounds, Water pollution, Water pollution effects, Population exposure, Pollutants, Water pollution sources, Classification, Reviews.

The current state of knowledge concerning the relationship between cancer incidence and organohalogen pollution of drinking water is presented by means of a literature review of investigations of the levels of halogens in drinking water, classification systems for aquatic carcinogens, epidemiological studies and animal experiments. Although numerous organic compounds, including halogen derivation have been identified as carcinogens in animal and in vitro studies, uniform or comparable methods of study have been used in only a few cases. While carcinogenic or suspected carcinogenic halogen derivatives have been found in concentrations of micro- or submicrograms in drinking water, chronological and geographical differences in degree of pollution have made quantitative statements as to the level and significance of human exposure extremely difficult. The number of epidemiological studies (both those that deal with a possible relationship between cancer and drinking water quality in general and those that focus on specific carcinogens) is too small to prove a relationship between halogens and cancer. Risk cannot be established because human exposure to halogens in drinking water is variable and unquantifiable; a combination of carcinogenic compounds in varying amounts exists in drinking water, whereas animal experiments have dealt with single compounds; a latency time of 5-40 yr before the appearance of cancers makes it difficult to assess present water pollution; many compounds have not yet been tested for carcinogenicity; and drinking water is not only carrcinogens to the human population. However, the studies reviewed do lead to the conclusion that organohalogens pose a potential cancer risk. (Gish-FRC)
W83-04064

IDENTIFICATION AND MUTAGENIC PROPERTIES OF SOME CHLORINATED ALIPHATIC COMPOUNDS IN THE SPENT LIQUOR FROM KRAFT PULP CHLORINATION,
Svenska Traeforskningsinstitutet, Stockholm.
For primary bibliographic entry see Field 5A.
W83-04094

1982 STOCKHOLM CONFERENCE ON ACIDIFICATION OF THE ENVIRONMENT,
For primary bibliographic entry see Field 5B.
W83-04095

ZOOPLANKTON DIVERSITY AND BIOMASS IN RECENTLY ACIDIFIED LAKES,
Ithaca Coll., NY. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W83-04103

RELATIONSHIP BETWEEN BODY-LEAD CONCENTRATION OF MYSIS RELICTA AND SEDIMENT-LEAD CONCENTRATION IN KOOTENAY LAKE, B.C.,
Trent Univ., Peterborough (Ontario).
R. D. Evans, and D. C. Lasenby.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 40, No 1, p 78-81, 1983. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Lead, *Lake sediments, *Aquatic biota, Mysis relicta, Sediment, Kootenay Lake, Canada, British Columbia, Effects of pollution, Heavy metals.

The relationship between sediment-lead concentration and organism-lead concentration is examined. If migrating benthic organisms are acting as metal pumps to return lead to the pelagic region from the sediments, one would predict a positive correlation between sediment-lead concentration and organism-lead concentration. Mysids collected at two different times during the summer at each station were analyzed for lead concentration. The differences in lead concentration for aparticular site ranged between 1 and 18%. The differences between stations in lead concentration were much greater. Average whole body concentrations ranged from 1.5 to 15 micrograms/g. In Kootenay Lake the lead concentration of the surficial sediments varied from 35 to 750 micrograms/g at the stations at which Mysis were collected. Water flow pattern in the lake was such that any movement of mysids would be from either the north or south end to the middle of the lake and ultimately out through the west arm. As a result of the unique spatial variation in sediment-lead concentration and water movement, it is unlikely that mysids ever move from areas of high contamination in the middle of the lake to areas of low contamintion at the north or south ends. A strong correlation was found between sediment-lead concentration and Mysis-lead concentration, which may indicate that Mysis can accumulate lead from the sediment and return it to the open water. (Baker-FRC)
W83-04104

TOTAL DISSOLVED SOLIDS AS A PREDICTOR OF LAKE BIOMASS AND PRODUCTIVITY,

Alberta Univ., Edmonton. Dept. of Zoology.
E. E. Prepas.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 40, No 1, p 92-95, 1983. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Lakes, *Productivity, Dissolved solids, Biomass, Chlorophyll, Nutrients, Morphoedaphic index.

Data were collected from 25 lakes located over a large region in central Alberta, in the drainage basins of three major river systems. The mean depth ranged from 2.4 to 19 m, summer epilimnetic total dissolved solids from 128 to 145 mg/liter, and average summer chlorophyll a collected from the trophogenic zone from 1.7 to 150 mg/cubic meter. No relationship was noted between TDS and chlorophyll in these lakes. Also no relationship was noted between mean summer epilimnetic TDS and TP, whereas TP and chlorophyll a were highly correlated. Thus TDS was not a good predictor of phytoplankton biomass as measured by chlorophyll a in these lakes. It was demonstrated that the mean depth was as good as predictor of fish production as the total dissolved solids:mean depth ratio, or the morphoedaphic index. (Baker-FRC)
W83-04106

LOW PH AND THE ABSENCE OF FISH SPECIES IN NATURALLY ACIDIC WISCONSIN LAKES: INFERENCES FOR CULTURAL ACIDIFICATION,
Wisconsin Univ.-Madison. Lab. of Limnology.
F. J. Rahel, and J. J. Magnuson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 40, No 1, p 3-9, 1983. 2 Fig, 3 Tab, 31 Ref.

Descriptors: *Acidic water, *Fish populations, Acid precipitation, Wisconsin, Lakes, Fish, Acidity.

Fish assemblages were examined in 138 northern Wisconsin lakes, many of which are naturally acidic. The pH range for these waters was 4.0 to 9.2. Differences were evident in the occurrence of species in relation to pH. Darters and most cyprinids were absent below pH 6.2, whereas black bullheads, yellow perch and several centrarchids occurred below pH 5.0. The central mudminnow occurred at the lowest pH, inhabiting bog drainage channels. In comparisons then made with long term laboratory bioassays, field manipulations of pH, and species disappearances in lakes affected by acid precipitation it was determined that species distributions in naturally acidic lakes generally agree with limits determined from these other studies. Discrepancies which occurred were generally minor, involving only a few tenths of a pH unit, or cold be explained by consideration of a species' autoecology. The data collected allow predictions of the relative acid sensitivity of many common fish species, and indicate the species assemblages typical of low-alkalinity, midwestern lakes vulnerable to acid precipitation. (Baker-FRC)
W83-04108

HISTORIC CHANGES IN AN URBAN WATERSHED DETERMINED BY POLLEN AND GEOCHEMICAL ANALYSES OF LAKE SEDIMENT,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
R. W. Mathewes, and J. M. D'Auria.
Canadian Journal of Earth Sciences, Vol 19, No 11, p 2114-2125, 1982. 6 Fig, 1 Tab, 37 Ref.

Descriptors: *Watersheds, *Sedimentation, Urban watersheds, Lake sediments, Copper, Lead, Erosion, Cesium, Pollens, British Columbia, Canada, Deer Lake.

Attempts were made to determine whether a record of human disturbance could be reconstructed from historical data and combined pollen and geochemical records of Deer Lake sediment. Palynological and geochemical studies were made on a 60 cm long sediment core to trace the effects of human disturbances since settelment. At 42.5 cm a settlement horizon was identified, about 1892, by pollen analysis. Declines in the percentages of coniferous tree species were mirrored by rapid increases in red alder and fern spores, and also by the presence of indicators of human influence, including introduced weeds, ornamental trees and herbs, and corn pollen. Marked increases in sedimentary aluminum, iron, potassium, titanium, and strontium soon after settlement coincided with declines in carbon, nitrogen, and sulfur. A corresponding shift from a highly organic gyttja to a silt- and clay-rich sediment also confirms the increased input up to the present day of inorganic sediment derived from soil erosion in the Deer Lake catchment. The deliberate introduction of copper sulfate around 1957 into the environment was recorded by a peak in copper at 19 cm. Increasing lead concentrations are correlated with post 1947-traffic increases. The peak radioactivity of cesium-137 at 17 cm correlated with the maximum in above ground bomb testing of 1963. Sediment accumulation rates were relatively constant from settlement until 1963, increasing to 1.06 cm/year since that time. An increased pollen influx since 1963 suggests a recent increase in runoff and soil erosion. (Baker-FRC)
W83-04110

SURFACE WATER CONTAMINATION BY INSECTICIDES: DATA FROM AQUATIC INSECT TESTS THAT PERTAIN TO WATER QUALITY CRITERIA,
Ohio State Univ., Columbus. Dept. of Entomology.
W. J. Collins, and R. Shank.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105378, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center Completion Report, September 1983. 75 p, 14 Fig, 7 Tab, 64 Ref. OWRT A-062-OHIO(1).

Descriptors: *Pesticide toxicity, *Aquatic insects, *Enzymes, Inhibitors, Acclimatization, Water quality, Water pollution, Metabolism, Respiration, Mayfly, Stonefly, Caddisfly, Midge, Winter, Summer, *Parathion, *Paraoxon, *Organophosphate insecticide, *Acetylcholinesterase, Mixed-function oxidase, Temperature effects.

Seven species of aquatic insects representing four orders were collected from natural waters in winter and summer seasons to investigate seasonal variation of toxicity of parathion and paraoxon, oxidative metabolism of these two chemicals and inhibition of acetylcholinesterase by paraoxon. Parathion was more toxic than paraoxon to both summer and winter forms of insects at 22C and 4C, respectively. The acetylcholinesterase of summer and winter forms exhibited the same inhibition characteristics with paraoxon. There was no evidence for the existence of different seasonal isoenzymes of acetylcholinesterase in these species. Parathion is oxidatively metabolized (mixed-function oxidase) in aquatic insects but paraoxon was not. The toxicity of parathion was highest in those insects with the highest oxygen consumption. A midge exposed to parathion acquired high (> 85%) inhibition of acetylcholinesterase before toxic symptoms were observed and inhibited acetylcholinesterase required 4 to 5 days for regeneration. These data are related to water quality criteria for parathion and provide information on seasonal variation of susceptibility to organophosphate insecticides in aquatic insects.
W83-04139

EFFECT OF HARDWOOD LEAF LITTER ON WATER QUALITY AND TREATMENT IN A WESTERN OREGON MUNICIPAL WATERSHED,
Oregon State Univ., Corvallis. Dept. of Forest Engineering.
R. L. Taylor, P. W. Adams, P. O. Nelson, and R. J. Seidler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105410, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-82, Oregon State Univ., Corvallis, September 1983. 56 p, 11 Fig, 5 Tab, 34 Ref, 10 Append. OWRT A-058-ORE(1), 14-34-0001-2139.

Descriptors: *Forest litter, *Leaf litter, Riparian vegetation, *Red Alder (Alnus rubra), *Municipal watersheds, *Watershed management, Watershed protection, Water quality, Water quality management, Water treatment, Water supply, Water color, Leaching, *Organic matter, *Organic carbon, Phenols, Trihalonethane, Chlorination, Coagulation, Bacteria, Coliforms, *Oregon, Seaside municipal watershed.

Riparian red alder stands are common in western Oregon and have been suspected in causing domestic water quality and treatment problems during autumn leaf fall. Studies on the Seaside Municipal Watershed showed potential water quality effects (particularly increased color) from alder leaves during unusually low autumn flows, but 1981-82 monitoring revealed no chronic problems. Laboratory leaching of alder leaves in filtered stream water indicated a fairly constant release of colored organics over time; water color increased linearly with increasing leaf mass leached. Ultraviolet absorbance (254 nm) related strongly to dissolved organic carbon levels in the leaf extracts. Chlorine demand of the extracts, based on total organic carbon (TOC), averaged 1.7 mg Cl sub 2/mg TOC. Trihalomethane (THM) formation in the extracts increased as pH and Cl sub 2/TOC ratio increased, with 60 mg CHCl sub 3/mg TOC formed at pH = 8.5 and Cl sub 2/TOC ratio = 4.3/1. Natural organics in stream water from the Seaside watershed produced less THM's and chlorine demand per mg TOC than the extracts. Coagulation with a cationic polyelectrolyte was partially successful in removing organics from the extracts. Observed chlorine demand and rapid regrowth of coliform bacteria in extracts suggest potential disinfection problems where alder leaf inputs are significant.
W83-04142

PHYTOPLANKTON UPTAKE AND SEDIMENT RELEASE OF NITROGEN AND PHOSPHORUS IN THE CHOWAN RIVER, NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
E. J. Kuenzler, K. L. Stone, and D. B. Albert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105444, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 186, North Carolina State Univ., Raleigh, September 1982. 159 p, 40 Fig, 18 Tab, 145 Ref, 1 Append. OWRT B-127-NC(12), 14-34-0001-0274.

Descriptors: *Eutrophication, *Nutrients, *Limiting nutrients, *Phytoplankton, Algae, Cyanophyta, Seston, Nitrogen, Nitrate, Ammonium, Phosphorus, Phosphate, Sediments, Radioactive tracers, *North Carolina, Chowan River, Algal blooms.

The lower part of the Chowan River has suffered from blue-green algal blooms in recent years as a result of increased loading of nutrients. These nutrients(nitrate, ammonium, and phosphate) were reduced to lower concentrations during the warm seasons when algal growth was rapid and were more concentrated in winter and early spring when ammonium and phosphate were introduced by pulp-mill effluent. Uptake of ammonium by seston varied greatly; it was fastest during the blue-green bloom. Nitrate uptake averaged only a third as fast as the annual ammonium uptake rate. Phosphate uptake was predominantly biotic; the rates varied, with highest rates occurring at downstream stations in warm weather when algae were abundant. Fluxes of ammonium and phosphate from the sediments to the water were highly variable. Although nitrogen and phosphorus are abundant in the sediment, the rate of exchange to the overlying water is not the basic cause of the eutrophic condition of the water column. Analysis suggests that nitrogen or phosphorus may limit algal growth at different times and places in the river. However, indications are that phosphorus is the more important limiting nutrient. Elimination of the algal bloom problem in the Chowan River will be accomplished only by reducing nutrient loading from the watershed, especially phosphorus loading.
W83-04146

ECOLOGY AND VIRULENCE OF LEGIONNAIRE'S DISEASE BACTERIA IN AQUATIC HABITATS NEAR MT. ST. HELENS,
Oregon State Univ., Corvallis. Dept. of Microbiology.
D. L. Tison, and R. J. Seidler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105493, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-84, Oregon State Univ. Corvallis, September 1983. 12 p, 3 Fig, 1 Tab, 9 Ref. OWRT A-060-ORE(1), 14-34-0001-2139.

Descriptors: *Legionella, *Legionnaire's disease bacteria, Bacteria, Aquatic bacteria, Diseases, Aquatic habitats, *Mt. St. Helens, *Spirit Lake, *Washington.

Illnesses among researchers exposed to lakes and streams in the Mt. St. Helens blast zone after the 18 May 1980 eruption prompted us to determine the occurrence and potential virulence of Legionella (Legionnaire's disease bacteria) in aquatic habitats near Mt. St. Helens during the summers of 1981 and 1982. Concentrations of L. pneumophila, L. Micdadei, L. gormanii, L. dumoffii, and L. bozemanii, determined by microscopic counts using direct immunofluorescent staining, ranged from <10 super 4 to 10 super 5 cs/L in lakes and rivers outside of the Mt. St. Helens blast zone while the numbers of Legionella in aquatic habitats inside the blast zone were from 10 super 5 to 10 super 7 cells/L. Legionella numbers were consistently highest in N. Coldwater and Spirit lakes, which received water from hydrothermal seeps. Legionella pneumophila serogroups 4 and 6 were isolated from N. Coldwater Lake in 1981 and from S. Coldwater Creek in 1982, indicating the potentially virulent strain of Legionella persist in aquatic habitats in the blast zone of Mt. St. Helens.
W83-04151

POLLUTION EFFECTS ON ECOBIOLOGY OF BENTHIC POLYCHAETES IN VISAKHAPATNAM HARBOUR (BAY OF BENGAL),
Andhra Univ., Waltair (India). Dept. of Zoology.
A. V. Raman, and P. N. Ganapati.
Marine Pollution Bulletin, Vol 14, No 2, p 46-52, 1983. 5 Fig, 2 Tab, 15 Ref.

Descriptors: *Benthic fauna, *Organic wastes, *Sediments, Water pollution effects, Visakhapatnam Harbor, Bay of Bengal, *India, Polychaetes, Invertebrates, Industrial wastes, Water circulation,Tidal currents, Fate of pollutants, Harbors.

The physiochemical and biological characteristics of six stations along a decreasing gradient of organic pollution were studied in Visakhapatnam Harbor, India, during 1976-77. An outer harbor, finished in 1975, had further reduced sluggish water circulation and tidal flushing. The harbor receives municipal and industrial effluents. The benthic fauna were predominantly polychaetes (72 species). Three distinct assemblages were noted: Capitella capitata-Nereis glandicincta in the inner harbor, Cossura coasta-Tharyx marioni in the outer harbor, and Chloeia-Axiothella-Chaetozone-Nephtys in the open sea. Four zones were defined: very polluted (within 150 m of the sewage outfall, no bottom life, septic sediments); polluted (most of the inner harbor, 12 species of polychates); semi-healthy zone (outer harbor, 20 species of polychaetes); and healthy zone (open sea, 50 species of polychaetes). Dissolved oxygen levels in the water varied from nearly zero near the outfall to saturation in the open sea. Organic content of the sediment ranged from 7.31% at the outfall to 3.5% in the inner harbor, 2.1% in the outer harbor, and 0.93% in the open sea. (Cassar-FRC)
W83-04165

THE DEPAUPERATION OF EPIFAUNA ON PINNA BICOLOR NEAR A LEAD SMELTER, SPENCER GULF, SOUTH AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Cronulla (Australia). Div. of Fisheries Research.
T. J. Ward, and P. C. Young.
Environmental Pollution, Series A, Vol 30, No 4, p 293-308, 1983. 3 Fig, 6 Tab, 22 Ref.

Descriptors: *Mollusks, *Heavy metals, *Water pollution effects, *Marine sediments, *Benthic fauna, *Species composition, Lead, Marine animals, Species diversity, Ecological effects, Organic carbon, Water pollution sources, Spencer Gulf, *Australia.

Species richness and composition of the epifauna on Pinna bicolor, a large benthic bivalve mollusk, were examined near a lead smelter located on Spencer Gulf, South Australia. Mollusks were collected from areas of high and low sediment metal concentration. Two independent gradients were found in the species composition of the epifauna. The first gradient extended from the contaminated to the less contaminated areas, while the second passed from shallower sites toward deeper sites. The first faunal gradient correlated with numerous sediment parameters such as Ca, Ni, total organic carbon, clay, Cu, Mn, Pb and Zn, suggesting an epifaunal response to both contaminant metals and the resuspension of solids from the sediments. Of the 55 taxa of epifauna, 13 were associated with the faunal gradient between metal-contaminated and uncontaminated areas. More bryozoan and sponge species than mollusk species correlated to this change, suggesting differing sensitivities to the causal factors. (Geiger-FRC)
W83-04174

CONTINUED STUDIES OF ACID RAIN AND ITS EFFECTS ON THE BATON ROUGE AREA,
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W83-04186

A NOTE ON THE GROWTH OF THIOTHRIX IN ROAD DRAINAGE DITCHES,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5B.
W83-04199

5D. Waste Treatment Processes

EXTRACTION OF PRIORITY POLLUTANTS FROM SOLIDS,
Iowa State Univ., Ames.
D. E. Harrold, and J. C. Young.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1211-1227, December, 1982. 9 Fig, 3 Tab, 20 Ref.

Descriptors: *Organic compounds, *Organic solvents, Pollutant identification, *Separation techniques, Model studies, Fate of pollutants, Organic acids, Volatile acids, Activated carbon, Gas chromatography, Pollutants, *Waste recovery, *Recycling, *Wastewater treatment.

The growing interest in the recycling waste materials has made the identification and fate of organic pollutants in solid matrices an area of great concern. Tests have been formulated to determine the efficiency of using Soxhlet procedures for the extraction of semivolatile organic priority pollutants from solid samples. Twenty-one compounds found on the EPA list of semivolatile organic priority pollutants were extracted from model sample systems consisting of mixtures of distilled water and granular activated carbon solids. Test variables included the time of solvent contact, particle size of solid matrix, and type of solvent. Extraction efficiencies varied substantially for different priority pollutants, and solvent losses significantly affected recovery when extraction times exceeded 24 hr. The most vital factor in obtaining maximum recovery seemed to be the contact time during extraction. Benzene was the best solvent for the extraction of semivolatile organics in the solids model and extraction procedures used. Particle size had only a minor effect on extraction efficiency. The Soxhlet procedure is useful in estimating the quantitites of semivolatile priority pollutants in solids when extraction efficiencies and other sources of error are taken into account. (Geiger-FRC)
W83-03859

EFFECT OF TILE DRAINAGE ON DISPOSAL OF SEPTIC TANK EFFLUENT IN WET SOILS,
Oregon State Dept. of Environmental Quality, Portland.
S. A. Wilson, R. C. Paeth, and M. P. Ronayne.
Journal of Environmental Quality, Vol 11, No 3, p 372-375, 1982. 4 Tab, 23 Ref.

Descriptors: *Septic tanks, Drainage systems, *Saturated soils, Willamette Valley, *Oregon, *Tile drains, Wastewater treatment, Wastewater disposal, Coliforms, Nitrates.

Tile drainage installed around septic tank disposal fields allowed effective aerobic decomposition of the effluents in the poorly-drained soils of the Willamette Valley, Oregon. Tile drains were either 1.2 m deep with a 3 m horizontal separation from the disposal trenches or 1.8 m deep with a 6 m separation. Water table drawdowns were 94 to 117 cm in the 1.8 m deep system and 56 and 75 cm in the 1.2 m deep system. In some fields poor drawdown was caused by the influences of old field tile. Nitrate levels in tile drain discharges were all below the 10 mg per liter drinking water standards. Fecal coliform levels were below 200 organisms per 100 ml, except for 2 systems. (Cassar-FRC)
W83-03879

EFFECTS OF DETERGENT FORMULATION ON THE PERFORMANCE OF SEPTIC SYSTEMS,
For primary bibliographic entry see Field 5B.
W83-03924

ENERGY-EFFICIENT AERATION OF ACTIVATION BASINS (ENERGIEFREUNDLICHE BELUFTUNG VON BELEBUNGSBECKEN),
W. Grimmel.
Waser, Luft und Betrieb, Vol 25, No 1/2, p 30-31, January/February, 1981. 3 Fig, 4 Tab, (No English Summary).

Descriptors: *Aeration, Activated sludge process, *Energy, *Wastewater treatment, *Design criteria, Installation, Economic aspects, Costs, Construction costs, Reverse current aeration, Biological oxygen demand, Nitrification, Phosphorus removal, Basins, Air circulation.

The IBO reverse current aeration system for sludge activation basins is described. Along the inner walls of the basin, aeration pipes are installed at regular intervals near the floor, while a concave sheet-steel cylinder containing a slowly rotating propeller is mounted in the basin's center. Small air bubbles rise to the surface by means of a spiral forced upward current, while the main current is directed downward. The path of the air bubbles is significantly lengthened by this circulating reverse current, which results in a higher level of oxygen exploitation. Ascent speeds lie between 15 and 26 cm/sec, which alows a through mixing of the biomass and a high degree of contact surface renewal. In trial runs it was shown that the system results in performance levels at least 25% higher than those attained by other aeration procedures. Turbulence speeds were 25-30 cm/sec near the basin floor, high enough to prevent activated sludge deposition. In some trials, automatic oxygen control was used for the various stages of the compressor; in others, a continuous compression drive was used (air/oxygen yield was 2.25-2.80 kg 02-kilowatt hr). During a long-range trial, energy consumption was 0.83 kilowatt hr/kg 5-day BOD, which is considerably less than the minimum level reported to date in the literature (1.0 kilowatt hr/kg 5-day BOD). When an activated sludge basin using rotation aeration was converted to reverse current aeration, daily energy consumption was halved (240 vs 110 kilowatt hr); 5-day BOD degradation was almost 98%, nitrification level was $>$ 90%, and phosphate removal was $>$ 70%, while with rotation aeration COD and 5-day BOD degradation and other parameters were an average of

30% lower. The advantages of the system include problem-free regulation, optimal aeration that covers the amount of oxygen actually required at a given time, flexibility to cover variable loads, cost savings due to low energy consumption, high purification level, simple conversion possibilities, and reasonable investment costs. (Gish-FRC)
W83-03925

THE JET NOZZLE--A NEW SUBMERGED AERATOR (DIE STRAHLDUSE--EIN NEUER TAUCHBELUFTER).
Wasser, Luft und Betrieb, Vol 25, No 7/8, p 18-19, July/August, 1981. 3 Fig. (No English Summary).

Descriptors: *Nozzles, *Jets, *Aerators, *Activated sludge process, *Industrial wastewater, *Wastewater treatment, *Belgium, Jet nozzle, Aeration, Momentum transfer, Oxygenation, Denitrification, Oxygen transfer, Biological wastewater treatment.

The use of a jet nozzle as a submerged aerator in the sludge activation basin is described. The system is in use at a biological wastewater treatment plant in Antwerp (Belgium) that serves 25 industrial works and discharges effluent into the Schelde river. The jet nozzle operates in a horizontal position on the floor of the activation tank. Activated sludge is continuously pumped into the power jet nozzle, where it is accelerated into a fast free jet, which draws in approximately ten times its original volume flow from the surrounding activated sludg through transfer of momentum. After it leaves the jet nozzle, the power jet enters a momentum exchange pipe, while the liquid it has absorbed flows through the area where the free jet leaves the mouth of the nozzle. Thus the air leaving the air nozzle (which surrounds the power jet nozzle) is dispersed in the shear field between the fast power jet and the slow-moving surrounding matter and is also mixed with a large amount of liquid in the turbulent momentum exchange. This results in small air bubbles being kept apart rather than forming larger bubbles with a smaller surface area. A rotation of the air/liquid mixture around a horizontal axis is achieved by the combined action of the forward-directed flow momentum and the uplift drive of the air bubbles. This results in the air bubbles returning to the bottom of the basin after they have risen to the surface, so that they remain in the liquid longer. This phenomenon, together with the small bubble size (large contact zone area), ensures an effective oxygen transfer. (Gish-FRC)
W83-03926

WASTEWATER TREATMENT WITH INDUSTRIAL OXYGEN (ABWASSERBEHANDLUNG MIT TECHNISCHEM SAUERSTOFF),
Linde A.G., Hollriegelskreuth (Germany, F.R.).
K. -H. Gregor.
Wasser, Luft und Betrieb, Vol 25, No 6, p 14-15, June, 1981. 3 Fig, (No English Summary).

Descriptors: *Oxygenation, *Industrial wastewater, *Municipal wastewater, *Wastewater treatment, *Water treatment, Unox procedure, Drinking water, Sludge thickening, Sludge digestion, Aerobic treatment, Nitrification, Denitrification, Nitrogen removal, Oxidation, Ozonation, Flotation, Separation techniques, Oxygen, Disinfection.

Various uses of the Unox (Lindox in the Federal Republic of Germany) procedure in wastewater treatment are described. The procedure is employed for treating municipal wastewater (including nitrification), sludge from domestic wastewater treatment plants, and industrial wastewater, and is particularly effective for wastewater that is difficult to treat, e.g., water with highly variable pollution loads and with malodorous constituents. Unox is a space-saving system that allows aeration with smaller basin volumes than in conventional methods. Nitrogen elimination rates of > 90% are achieved through a nitrification/denitrification procedure. Unox offers aerobic thermophilic (as well as mesophilic) sludge stabilization, in which excess sludge is stabilized through the introduction of oxygen. A new dual digestion (DD) system has been devised that combines this aerobic sludge treatment with conventional digestion. DD is characterized by significantly shorter retention times (smaller digestion volume). Unox is used together with ozonation (ozone is manufactured from industrial oxygen, which is used for aeration in Unox) for disinfection in drinking water treatment. Waste gas from Unox facilities contains more oxygen (about 50%) than air, so is more soluble in aqueous solutions. Thus the use of this gas instead of air in sludge thickening results in a higher concentration of flotated solids, greater throughput volume for a given flotation chamber volume, and cost reduction through decreased energy requirement to release flotation gas. New systems are being developed, e.g., for heavy metal removal from sludge. (Gish-FRC)
W83-03927

PRESSURE-RELEASE FLOTATION. PRACTICAL EXPERIENCE FROM SWEDEN (ENTSPANNUNGSFLOTATION. PRAKTISCHE ERFAHRUNGEN AUS SCHWEDEN).
Wasser, Luft und Betrieb, Vol 25, No 9, p 18, 23, 24, September, 1981. 3 Fig, (No English Summary).

Descriptors: *Flotation, *Water treatment, *Wastewater treatment, *Sludge thickening, *Tertiary wastewater treatment, *Sweden, Pressure-release flotation, Drinking water, Sedimentation, Precipitation, Suspended solids, Algae, Filtration.

Water quality demands in Sweden are high. The technique of pressure release flotation is used in Sweden in wastewater treatment facilities with a throughput of up to 16,000 cu m/hr. The procedure involves reintroducing treated water into the treatment basin inlet and saturating it with air in a pressure tank before mixing it with the basin contents. Gas bubbles that are freed by the reduction in pressure attach themselves to dirt particles and carry them to the surface. Air bubbles of 30-80 micron are produced, a size that cannot be achieved through direct injection. The advantages of pressure-release flotation are significantly increased throughput and better purification capacity due to the small size of the bubbles. Higher sludge concentrations result, sometimes obviating the need for further thickening. The procedure has long been used successfully for drinking water treatment, raw materials recovery and water recycling, industrial and municipal wastewater treatment, and sludge thickening. In a comparison study at a drinking water treatment plant (capacity up to 600 cu m/hr), chemical use was one-third less for pressure release flotation than for sedimentation, and drinking water production doubled with flotation; the reason for this was the high level of suspended matter removal (especially algae). A further development is to combine pressure-release flotation with filtration using a flotation filter, for use in the treatment of high-quality water. (Gish-FRC)
W83-03928

THE OPERATION, MAINTENANCE AND RENOVATION OF SEWERAGE SYSTEMS AND PUMPING STATIONS IN A LARGE MUNICIPALITY,
J. W. Sellek.
Water Pollution Control, Vol 81, No 5, 645-654, 1982. 6 Fig, 2 Tab, 4 Ref.

Descriptors: *Sewer systems, *Rehabilitation, *Inspection, Manchester, *England, Maintenance, Cleaning.

The sewer system of Manchester, England, dating back to 1792, has required many repairs in recent years. The operation and maintenance work has been complicated by a lack of records for the period before 1830. Most of the early system is not large enough for man entry. Therefore, inspection and cleaning has been inadequate. Highway subsidence (50 cases since 1976) is frequent and expensive to repair. A plan for maintenance and renovation of the sewer system has been devised. Inspection via man entry or television will be directed first toward the main interceptors, then the local distributing sewers (oldest sewers and most important roads first) and local sewers. A program for manhole construction in the older sections will improve access. Of the methods available for renovation and renewal, reconstruction is the most expensive but most satisfactory, having an anticipated life of up to 150 years. For sewers in early stages of deterioration, cleaning, repointing, and grouting are satisfactorily, but labor-intensive, techniques. (Cassar-FRC)
W83-03929

OXYGENATED ACTIVATED-SLUDGE PROCESS: EVALUATION AT PALMERSFORD,
Water Research Centre, Stevenage (England).
A. J. Blachford, E. M. Tramontini, and J. A. Griffiths.
Water Pollution Control, Vol 81, No 5, p 601-618, 1982. 8 Fig, 11 Tab, 41 Ref.

Descriptors: *Activated sludge, *Oxygenation, *Biological wastewater treatment, Palmersford, *United Kingdom, Aeration, Unox process, Bulking sludge, Energy.

An oxygenated activated sludge plant (OASP), also known as the Unox system, was installed in 1975-76 at Palmersford, England. This plant has treated 5.1 tcmd of settled sewage at a sludge loading rate of 0.46 kg per kg-day to produce an effluent with median values of 5 mg per liter BOD, 9 mg per liter suspended solids and 26% nitrification. Complete nitrification was achieved in the aerated second stage of treatment. Increasing the sludge loading to 0.98 kg per kg-day increased the BOD to 21 mg per liter and the suspended solids to 26 mg per liter. Compared with a conventionally aerated system the OASP produced a similar effluent with less nitrification and 21% less sludge. Energy required by the OASP process was 1.8-4.1 kWh per kg BOD and ammonia oxidized. Energy use was 70% higher than in the conventional aerated plant per unit of sewage treated. The pressure swing absorption unit, which generates oxygen, has been nonoperational only 5.6% of the time. (Cassar-FRC)
W83-03930

EFFECTIVE USE OF STOM,
Water Research Centre, Stevenage (England).
R. H. Chambers, and B. W. Spearing.
Water Pollution Control, Vol 81, No 5, p 655-664, 1982. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Model studies, *Performance evaluation, *Activated sludge process, *Wastewater treatment, Sewage Treatment Optimization Model, STOM, Design criteria.

The Sewage Treatment Optimization Model (STOM), designed to help in design and operation of new and extended sewage treatment works, has been used extensively since late 1980. It can be used in 2 modes: fixed-mode, for calculating the performance and cost of a given works from the flow rate and composition of influent, and optimized-mode, to give the specified effluent for the minimum annual treatment cost. Thus far, the major use of the model has been in improving performance or planning extensions of existing works. One problem with the model has been insufficient performance, operational, and design data for input into the model. Especially important, but often unknown, are type and size of biological filter media, mixed liquor suspended solids concentrations in the activated sludge stage, and the temperature of the sewage. Proposed additions to the model include provision for hot climates, anoxic zones, nitrifying filters, and humus-settlement tanks. (Cassar-FRC)
W83-03931

MARKET CHANCES FOR MEMBRANE PROCEDURES IN THE 1980S (MARKTCHANCEN FUR MEMBRANVERFAHREN IN DEN 80ER JAHREN),
Gesellschaft fuer Wirtschaftsforderung und Marktplanung m.b.H., Frankfurt am Main (Germany, F.R.).
G. Dippel.
Wasser, Luft and Betrieb, Vol 25, No 4, p 17, 18, 23, April, 1981. (No English Summary).

Descriptors: *Membrane processes, *Reverse osmosis, *Ultrafiltration, *Marketing, *Forecasting, Projections, Predictions, Membrane filters, Filtration, Wastwater treatment, Water treatment, Milk, Dairy industry, Disinfection, Oily water, Metal-finishing wastes, Food processing industry, Wash water, Economic aspects, Costs.

Results of a 1979 West German study are reported, in which the possiblities for installation of membrane filtration processes (ultrafiltration, UF, and return osmosis, RO) in various industries for the 1980s were assessed. Although approximately 55,000 companies were studied, it is expected that for technical and economic reasons, only about 3,500 membrane filtration facilities will be installed by 1990. About two-thirds of these will be UF plants, most of which will be used in the metal and milk processing industries. For RO facilities, the most important markets will be the treatment of boiler feed water, followed by water treatment for air conditioning systems (particularly where a high degree of disinfection is required, e.g., in industrial sterile rooms and hospitals) and for hemodialysis water for hospitals. In the metal processing industries, additional possible applications include the separation of oil-water mixes (UF has been used successfully and cost-effectively here), electro-dip lacquering (UF use can result in lacquer recovery of up to 95% and has cost advantages), purification of wash water (RO), and treatment of oily wastewater (UF). RO has been considered as a supplement to ion exchange for wash water desalination in the galvanizing field, but no facilities are foreseen for both technical and cost reasons. In the food industry, no applications are expected other than in the milk sector, though membrane procedures have been considered for the manufacture of alcohol-reduced beer (RO), wine production, fruit-juice concentration (RO could possibly be used commercially in a few instances here), meat and fish processing (UF for protein concentration from wastewater, cooking and wash waters, and blood), and nutrient production (e.g., UF for yeast wash water treatment). Technical development is not yet refined enough to allow widespread use of membrane filtration in the chemical and pharmaceutical industries. Possible future applications are expected in the textile, cellulose and paper (RO for wastewater treatment), and leather (UF for process water treatment) industries. (Gish-FRC)
W83-03941

CIRENCESTER CARROUSEL PLANT: SOME PROCESS CONSIDERATIONS,
Thames Water Authority (England). Cotswold Div.
D. W. M. Johnstone, and W. F. Carmichael.
Water Pollution Control, Vol 81, No 5, p 587-600, 1982. 7 Fig, 1 Tab, 11 Ref.

Descriptors: *Oxidation ditches, *Nitrogen removal, *Oxygen requirements, Wastewater treatment, Cirencester Plant, *United Kingdom, Carrousel process, Aeration, Ditches, Biological wastewater treatment, Sludge digestion, Performance evaluation, Digestion, Nitrification, Denitrification, Anaerobic conditions.

Operational data collected from 1977 to 1980 at the Cirencester Carrousel plant (oxidation ditch) yielded information on oxygen requirements, energy consumption, and factors affecting nitrification/denitrification. Equations were developed to describe theoretical oxygen demand, which varied from 2000 to 4000 kg per day. Sludge respiration was the most significant component of the oxygen requirement, which also considered oxidation of carbonaceous substrate and nitrification/denitrification. Inorganic N removal varied from zero to 90%. Nitrification was impaired during a period of rising mixed liquor suspended solids and rising temperature. Full denitrification occurred during a three month period of excess oxygen supply and during a 5 month period of very low effluent ammonia and nitrate concentrations with large anoxic zones. Diurnal variations in sewage concentration and volume made control of denitrification difficult due to a lag in the size of the anoxic zones. (Cassar-FRC)
W83-03944

INITIAL OPERATING EXPERIENCES OF UPRATING DISS SEWAGE TREATMENT WORKS USING THE BOC VITOX SYSTEM,
Anglian Water Authority, Norwich (England). Norwich Sewage Div.
B. V. Crook, D. B. Cudby, and C. Jeffries.
Water Pollution Control, Vol 81, No 5, p 633-644, 1982. 3 Fig, 7 Tab, 8 Ref.

Descriptors: *Vitox system, *Oxidation ditches, *Wastewater treatment, Pasveer Ditch, Ditches, Diss, *United Kingdom, Oxygenation, Biological wastewater treatment, Sludge digestion, Digestion, Oxygen requirements.

The BOC Vitox System was incorporated into the Diss, England sewage treatment system to quickly uprate the existing unreliable Pasveer ditch. The system, installed within 6 weeks of ordering, restored stability to the poorly operating ditch and accomodated a 10-15% increase in sewage diverted from an adjoining village. Apparently about 30% of oxygen delivered to the site is lost for unknown reasons. Effluent contained 6.6 mg per liter BOD (98.4% removal), 17.4 mg per liter total suspended solids, 1.5 mg per liter ammonia-N (95.7% removal), and 28.5 mg per liter nitrates. For the Diss sytem the respiration rate at 20C was determined to be 6.5 mg 02 per g sludge per hour, higher than the published value of 3.9 mg 02 per g sludge per hour. (Cassar-FRC)
W83-03946

INITIAL OPERATING EXPERIENCES AT CIRENCESTER CARROUSEL PLANT,
Thames Water Authority (England). Cotswold Div.
W. F. Carmichael, and D. W. M. Johnstone.
Water Pollution Control, Vol 81, No 5, p 573-586, 1982. 8 Fig, 4 Tab, 7 Ref.

Descriptors: *Sludge digestion, *Aeration, *Oxidation ditches, Ditches, Wastewater treatment, Cirencester Plant, *United Kingdom, Carrousel process, Biological treatment, Performance evaluation, Digestion.

This paper describes the Cirencester Carrousel sewage treatment system and the initial operating results. After grit removal, sewage is pumped to an 88 m long aeration ditch, consisting of four 7 mile wide channels 2.5-3.5 m deep. The retention period is 33 hours. Facilities for tertiary treatment, storm water storage, and sludge thickening are also provided. This plant has been easy to operate. Aeration efficiency of the Simcar Aerators was highest (2.6 kg 02 per kWh) at 42% immersion. At a BOD loading of 732 kg per day (53% of design) good quality effluents were produced: 8 mg per liter BOD, 6 mg per liter ammonia, and 5.7-17.5 mg per liter suspended solids. Up to 90% removal of inorganic N occurred under eighter full nitrification or nitrification/denitrification. At high mixed liquor suspended solids nitrification and sludge settleability were impaired. Sludge production was 1 kg per kg BOD removed. Energy consumption was 1.2-2.1 kWh per kg BOD removed. (Cassar-FRC)
W83-03947

ASPECTS OF THE PERFORMANCE OF FINAL CLARIFIERS IN THE ACTIVATED SLUDGE PROCESS,
Stewart, Sviridov and Oliver, Marshalltown (South Africa).
C. Davis.
Water Science and Technology, Vol 14, No 9-11, p 1514-1518, 1982. 3 Fig, 4 Ref.

Descriptors: *Design criteria, *Activated sludge process, *Clarifiers, Clarification, *Wastewater treatment, Sludge.

Ideas regarding the design, detailing, monitoring and operation of clarifiers are considered. Designers now tend to consider flux in addition to upflow rate when sizing a clarifier. Without prior knowledge of the sludge characteristics, it is not possible to apply flux theory. Therefore the designer requires a design limit for flux. In the absence of theory to determine side wall depth for a clarifier, it is prudent to regard 3 meters as a safe minimum. Shallower tanks are prone to failure under shock loads. Apart from basic design and sizing, a clarifier also demands careful detailing. One particularly troublesome area is scum removal. For monitoring, the traditional measure of sludge characteristics is the SVI test. The plant operator can manipulate sludge age, oxygenation and sludge return ratio in order to optimize performance. For oxygen deprived plants with fairly long liquid detention times of 12-24 hr, a sludge age between 20 and 30 days can be expected to produce a good sludge. While some evidence has been suggested for bulking at low oxygenation rates, this was not the case at the plants studied. Sludge return ratio has a profound effect on the thickening, and it is best to restrict the return ratio to range of 0.5 to 4.0. Where alternating aerobic-anoxic-anerobic conditions are desired, use of high ratios can assist the cyclic effect, but may also lead to turbulence and clarifier failure. (Baker-FRC)
W83-03951

PRECIPITATION OF CALCIUM PHOSPHATE AND PH-EFFECTS IN DENITRIFYING BIOFILMS,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
E. Arvin, and G. H. Kristensen.
Water Science and Technology, Vol 14, No 9-11, p 1505-1508, 1982. 10 Fig, 2 Ref.

Descriptors: *Biofilms, *Denitrification, Acidity, Phosphates, Mathematical models, Hydrogen ion concentration, Chemistry of precipitation, Calcium compounds, *Wastewater treatment.

Denitrification was studied in a fixed bioflim. During denitrification alkalinity (bicarbonate and carbonate) is produced. Due to diffusional resistance to outtransport of alkalinity pH increases with depth into the biofilm. The solubility of calcium phosphate compounds decreases with the biologically mediated pH increase. Thus calcium phosphate might precipitate. The experiments were performed in a laboratory fixed film reactor fed with an artificial substrate. The pH is measured in the bulk liquid and at the rear of the biofilm. After growing the biofilm the reactor is disassembled and biofilm samples are scraped off for analysis. A carbonate apatite has precipitated in the biofilm. The pH-effect and a mathemathical model fo this has been verified. It is concluded that denitrification in a fixed biofilm can create pH values in the biofilm considerably higher than the pH in the external bulk liquid. The pH increase inside the biofilm can initiate calcium phosphate precipitation. (Baker-FRC)
W83-03952

BIOCHEMICAL CHANGES ASSOCIATED WITH LUXURY PHOSPHATE UPTAKE IN A MODIFIED PHOREDOX ACTIVATED SLUDGE SYSTEM,
Pretoria Univ. (South Africa). Dept. of Biochemistry.
D. J. J. Potgieter, and B. W. Evans.
Water Science and Technology, Vol 14, No 9-11, p 1503-1504, 1982. 1 Fig.

Descriptors: *Phosphates, *Activated sludge process, Biochemical reactions, *Wastewater treatment, Phoredox, Nutrients, Nutrient removal.

Biochemical events in an activated sludge system were studied before and during luxury phosphate uptake. The aim of the study was to discover critical biochemical reactions involved in luxury phosphate uptake, the control of which would lead to satisfactory control of such processes. The concept on which the study was based is that phosphate accumulation is mainly a biological process, and that it results from an imbalance in the supply of energy, carbon skeletons and nitrogen during critical stages of microbial proliferation. Meaningful amounts of nitrogen, hydrogen sulfide, carbon dioxide and oxygen with traces of methane were found. Hydrogen sulfide and nitrogen showed an inverse relation, while hydrogen sulfide increased as the system acclimatized to 100% P removal. Involvement of gas production in the creation of imbalance is probably indicated. ATP (bacterial

and somatic), DNA, polyphosphate, and PHB profiles are presented. Adenylate energy charge is calculated. The divalent cations of calcium and magnesium may play a role in transport processes connected with phosphate release and uptake. Total and free amino acids in sludge were monitored at various stages of P removal. The observation that a rise in total N and P in the cells leads to a corresponding increase in total amino acids is interpreted in terms of the concept that an imbalance in the supply of energy, carbon skeletons and nitrogen is responsible for luxury phosphate uptake. (Baker-FRC)
W83-03953

MICROBIOLOGY OF NUTRIENT REMOVING ACTIVATED SLUDGE,
Johannesburg City Health Dept. Labs. (South Africa).
M. A. Hart, and L. N. Melmed.
Water Science and Technology, Vol 14, No 9-11, p 1501-1502, 1982. 1 Tab.

Descriptors: *Activated sludge process, *Bacteria, Sludge, Nutrients, *Nutrient removal, Acinetobacter, Bulking sludge, Phosphates, Poly-beta-hydroxybutyrate, *Wastewater treatment.

A description is offered of the modified Bardenpho nutrient removal system. The build-up of microbiological life from plant start-up is recorded, and Acinetobacter spp is identified as a major component of the Gram-negative group of bacteria in a number of plants. Problems with filamentous organisms are described. In this process the microbial life is exposed to alternating degrees of stress. Such conditions may result in the natural selection of microbial species differing from those found in conventional systems. To gain more knowledge in this regard the 150 ml/d Johannesburg Northern Works was monitored daily from the time it was started up on settled sewage. After seven days a negligible number of flagellates were seen, but no floc was visible until the tenth day. Next to appear were free swimming ciliates and amoeba, followed by a gradual compaction of the floc and the appearance of Phadophyra among other attached and crawling ciliates. Methylene blue staining showed the presence of phosphate deposits in cells having a coccal, rod, chain and cluster appearance. Multizone nutrient removing activated sludge plants appear to suffer from poor settling sludges. Filamentous growths often float in thick mats on the surface, especially in winter. Nocardia has been found to be present at certain plants and Microthrix parvicella at others. Changing conditions to either highly aerobic or anaerobic has been partially successful in abating this problem. One plant which is switched off during weekends has minimal difficulties in this regard. (Baker-FRC)
W83-03954

THE LOCATION AND NATURE OF ACCUMULATED PHOSPHORUS IN ACTIVATED SLUDGE,
Johannesburg City Health Dept. Labs. (South Africa).
L. Buchan.
Water Science and Technology, Vol 14, No 9-11, p 1497-1500, 1982. 3 Fig.

Descriptors: *Activated sludge process, *Phosphorus, *Bacteria, Fermentation, *Wastewater treatment, Chemical reactions.

To obtain further detail on the morphology of phosphorus accumulating organisms and the composition of the phosphorus accumulations, specimens of various activated sludges were examined in a transmission electron microscope and a scanning electron microscope equipped with an EDX attachment. Phosphorus-rich inclusions were shown to take up a large volume of the cell and to be electron dense. They appeared to be hard, spherical bodies which were often pulled out of the cell by the microtome knife during sectioning, leaving holes in the cell structure. Further they did not exhibit the diffraction pattern characteristic of crystalline structures. However, they could be degraded by increasing the intensity of the electron beam, whereafter diffraction patterns could be discerned. During degradation it was noted that these phosphorus-rich inclusions appeared to contain a spherical body of low electron density. Granules in Acinetobacter contained in excess of 25% (m/m) phosphorus with a Ca:P ratio between 0.15 and 0.36. Accumulation was possible under continuous aerobic culture and was enhanced by the presence of fermentation products from raw sewage. (Baker-FRC)
W83-03955

DESTRUCTION OF HAZARDOUS WASTES BY ULTRAVIOLET CATALYZED OXIDATION,
Connecticut Univ., Storrs. Inst. of Water Resources.
D. W. Sundstrom, and H. E. Klei.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265090, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, April 1983. 18 p, 8 Fig, 10 Ref. OWRT A-092-CONN(1), 14-34-0001-2107.

Descriptors: *Photooxidation, *Halogens, *Hydrogen peroxide, *Chemical oxidation, *Ultraviolet radiation, Hazardous materials, Water purification, Water pollution, Wastewater treatment, Water treatment.

Conventional wastewater treatment processes are ineffective on many hazardous organic compounds found in industrial wastes and domestic water supplies. This project examined the destruction of hazardous organic compounds in water by ultraviolet light catalyzed oxidation with hydrogen peroxide. Reactions were conducted in a batch reactor equipped with a stirrer and a low pressure mercury lamp to provide the ultraviolet light. The course of the reactions with time were followed by analyzing for the pollutants with a gas chromatograph. The compounds examined in the initial study were trichloroethylene and dichloromethane, which are representative of halogenated compounds found in contaminated water supplies. Rates of oxidation increased with increasing pollutant concentration, hydrogen peroxide concentration and temperature. Starting with an initial concentration of about 50 ppm trichloroethylene, the concentration was reduced to less than 1 ppm in 50 min at 20C and 10 min at 41C. All of the reacted chlorine was converted to chloride ion, indicating that the halogenated compounds were destroyed. This treatment method can be applied to the destruction of a wide spectrum of hazardous industrial compounds before discharge to the environment and will also be of value to homes and institutions with contaminated water. In addition to destroying hazardous organic compounds, this technique also kills most bacteria and viruses. This technology should be fairly easy to implement since ultraviolet lamps are readily available and hydrogen peroxide is a common industrial and household chemical.
W83-04002

CONTROLLING SULFIDES AND ODORS IN SEWERS. PART TWO,
Johnson (Bernard), Inc., Houston, TX.
M. A. Vivona, and G. A. Whalen.
Public Works, Vol 113, No 4, p 69-72, April, 1982. 2 Fig, 5 Tab, 7 Ref.

Descriptors: *Sulfides, *Odor control, *Sewers, Aeration, *Wastewater treatment, Dissolved oxygen, Temperature effects, Pumping, Corrosion, Wastewater collection, Forcemains, Materials testing.

Force main aeration and adjunctive feed of hydrogen peroxide have been installed at the Westville and Clayton pump stations of the Gloucester County Utilities Authority in New Jersey in an effort to control sulfides and odors in the sewers. This article discusses technical details of the aeration system. Various aspects of aeration efficiency are examined, including relief valve losses, assessment of quantitative loss, selection of desirable air feed rates, and the effects of seasonal changes in wastewater temperature on desirable air feed rates. Methods for estimating the effect of air relief valve losses on the theoretical flow in force mains are demonstrated. Plans for future evaluations of this wastewater treatment program are described. (Carroll-FRC)
W83-04018

EXPERIENCE IN THE FIELD OF OIL REMOVAL FROM POWER PLANT WASTEWATERS (ERFAHRUNGEN AUF DEM GEBIET DER ENTOLUNG VON KRAFTWERKABWASSERN),
Institut fuer Energetik, Leipzig (German D.R.).
H. Schuster.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 5, p 473-483, May 1980. 4 Fig, 4 Tab, 13 Ref. (No English Summary).

Descriptors: *Oily water, *Powerplants, *Wastewater treatment, *Waste recovery, Recycling, Oil pollution, Emulsifiers, Emulsion, Filtration, Fuel oil, Fuel, Coal, *German Democratic Republic, Solids, Separation techniques, Oil wastes.

Depending on the fuel and technology of power plants, wastewaters with varying concentrations of oil and solids are produced, so that different methods of treatment must be used. In the German Democratic Republic, power plants fired by brown coal are important. In these, oil-polluted wastewater contains mostly oil that has leaked from the oil pipeline system, although the water-steam circulating and cooling systems are also subject to leaks. In power plants fired by fuel oil, oil-polluted water may originate in rainwater contaminated during oil delivery, wash water, and runoff from drainage of oil storage areas and the boiler house. Maintenance and repair facilities may also be sources of oil-contaminated water. Depending on its source, the polluted water may contain soot, surfactants, salts, or solids, and be acid or alkaline. Gravity separation can be used to remove oil from wash water and leakage in solid-fuel plants; after this a solids separator is used to remove coal and ash solids. A successful pilot study was conducted in an East German brown-coal-fueled plant to use xylitol-containing furnace residues for adsorptive removal of oil in condensate. For oil-fired plants, the goal is not only to clean the polluted water but also to recycle the oil, soot, and metals (especially V205) that they contain. Simple oil removal is sufficient to treat all but wash water from oil-fired facilities. Research is being conducted into separating oil-contaminated wastewater from these plants into pure oil and aqueous phases by means of membrane filtration. In one brown-coal-fired plant's workshop, a tube wash facility has been installed to treat water containing detergents, grease, and oil emulsion. The process includes emulsion breaking by decreasing pH and separation of oil-carrying ash particles by filtration. (Gish-FRC)
W83-04048

SOME ASPECTS OF THE PRESENT STATUS OF ALGAE CULTIVATION AND THEIR APPLICATION (NEKOTORYE ASPEKTY SOVREMENNOGO SOSTOYANIYA KUL'TIVIROVANIYA VODOROSLEI I IKH PRIMENENIE),
C. V. Dilov.
Khidrobiologia, Vol 10, p 3-11, May, 1980. 20 Ref.

Descriptors: *Agriculture, *Algae, *Wastewater treatment, Feeds, Chlorella, Aquatic productivity, Proteins, Nutrients, Aquaculture, Spirulina, Scenedesmus.

Use of algae grown in waste water for animal feed has acquired greater significance with increasing prices of protein and increasing water shortages. Algae projects, not using waste water, include 45 units in Southeast Asia producing 1,000 kg dry Chlorella monthly and Spirulina production in Mexico. Projects in Germany, Thailand, Peru, India, and Israel are studying mass production of Scenedesmus. At present Chlorella and Scenedesmus are not suitable for use as primary protein sources for human consumption but have potential application as food additives. (Cassar-FRC)
W83-04073

PURIFICATION OF FAECAL WATERS COMBINED WITH ALGAL PROTEIN PRODUC-

TION (OCHISTVANE NA VODI S FEKALEN KHARAKTER, SUCHETANO S POLUCHAVANE NA VODORASLOV PROTEIN),
K. M. Benderliev, and C. V. Dilov.
Khidrobiologia, Vol 10, 12-26, May, 1980. 101 Ref.

Descriptors: *Algae, *Waste water treatment, *Agriculture, Aquaculture, Proteins, Nutrients, Water conservation, Pilot plants.

Algae were used to purify waste waters in laboratory and pilot plant studies reviewed in this paper. In addition to providing for waste treatment, algae production conserves agricultural water resources and reuses nutrients to provide protein. Large-scale implementation of this process is not considered feasible at this time. (Cassar-FRC)
W83-04074

INTENSIVE CULTIVATION OF MICROALGAE IN WASTE WATER FROM A PIG-BREEDING FARM,
C. V. Dilov, K. M. Benderliev, N. V. Cherkesov, and A. P. Atev.
Khidrobiologia, Vol 10, 27-33, May, 1980. 3 Fig, 4 Tab, 12 Ref.

Descriptors: *Algae, *Waste water treatment, *Agriculture, Chlorella, Pig wastes, Farm wastes, Chlorophyta, Scenedesmus, Chlamydomonas, Aquatic life, Nitrogen, Phosphorus, Chemical oxygen demand, Bacteria, Ammonia, Waste treatment.

Wastewater from a pig breeding farm was depleted by about 80% in nitrogen, phosphorus, and COD during algae culture experiments. Chlorella sp 4 and Chlorella sp 16b were the most promising isolates because they were thermophilic, comparatively resistant to ammonia toxicity, and had a short lag period in a highly loaded medium. Scenedesmus sp. showed some domination in mixed cultures. Also tested, but found noncompetitive, were Chlamydomonas, Euglena, Chlorogonium, Pyrobotrys, and Tetraedron. During an outdoor experiment algal-bacterial purification was more effective than bacterial alone, removing 1.5 to 2 times as much ammonia nitrogen and phosphates. COD removal was slightly higher than in the control. The algal-bacterial combinations used 57.14% of the nitrogen versus 26.14% for the control. Nitrogen lost was 40% in the algal-bacterial experiment; 74% in control. (Cassar-FRC)
W83-04075

DEEP TANK AERATION/FLOTATION, CLARIFICATION ADDS A NEW TREATMENT DIMENSION,
D. Rogers.
Industrial Wastes, Vol 29, No 1, p 10-17, 1983. 2 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Clarification, Aeration, Flotation, Energy conservation, Secondary wastewater treatment, Bacteria, Activated sludge process.

An innovative treatment facility at a Washington state pulp and paper mill proved the capabilities of the deep tank aeration/dissolved air flotation process in a difficult industrial application. The ITT Rayonier secondary treatment system is a variation of conventional high rate activated sludge systems, using deep tank aeration to provide a completely mixed aerobic environment for biological treatment. Secondary clarification is accomplished through the use of dissolved air flotation. The secondary treatment facility was designed to treat an average daily flow of 30 mgd with a raw waste loading of 310,000 lb BOD/day and 19,800 lb TSS/day. As a result of a partial sewer reorganization and a reduction in mill water usage, the treatment plant currently processes an average daily flow of 25 mgd, or about 85% of design capacity, and has a slightly longer detention time of 10.3 hr than design. About 15 mgd of untreated pulp mill process wastewaters are discharged with the treatment plant effluent after pH adjustment. During the three year operation of the treatment plant the overall BOD removal efficiency has averaged 85%, while soluble BOD removal was 97%. Soluble BOD accounted for only 23% of the effluent BOD, whereas it accounts for over 95% of the influent BOD. Effluent BOD and average SS discharges have been influenced greatly by grade changes, primarily changes from low to high RWL grades, where influent BOD loadings can increase by over two-fold in just a few hours. The average F/M ratio, while much higher than in conventional treatment plants, is below design. Since the influent TSS is only 50 mg/l, the MLSS in the tanks represents mostly bacterial cells. Also, the MLSS represents a high concentration of active cells because of the high F/M ratio and low sludge turnaround time from the clarifiers, about 15 min. Oxygen uptake rates range from 50 to 60 mg/l/hr and a corresponding respiration rate of 30 to 40 mg/g/hr. Secondary clarification by flotation is a reliable process. (Baker-FRC)
W83-04085

MEETING REGULATORY REQUIREMENTS THROUGH MINOR PLANT MODIFICATIONS,
Edde (Howard), Inc., Bellevue, WA.
H. Edde, J. Handley, G. Conn, and J. McDaniel.
Industrial Wastes, Vol 29, No 1, p 18-19, 1983. 2 Fig, 1 Tab.

Descriptors: *Wastewater treatment facilities, *Design criteria, Decision making, Aeration, Mixing, Biochemical oxygen demand.

Significant improvements were achieved in aeration tank mixing and an increase in tank volume was obtained through relatively simple and low cost piping modifications made at the Kalama Chemical Plant in Kalama, Washington. The following changes were responsible for the improvements. A 75 hp high speed aerator was replaced with a 125 hp diffused air system. Although effective in improving aeration tank mixing, it also increased the wastewater temperature and required more maintenance. The addition of river water to the treatment plant feed to control high operating temperatures was successful, particularly during the summer season when these temperatures were of great concern. Even with these changes the system was still subject to severe upsets when stressed by high temperatures of phenol spills. The settling characteristics of the sludge were poor, resulting in poor effluent quality and operational problems. The poor mixing in the aeration tank resulted primarily from improper design in the aeration tank piping. The return sludge should mix with the fresh wastewater feed at a point of intense agitation. A lithium tracer study revealed significant short-circuiting and dead spots within the aeration tank. The poor placement of the return sludge entrance, inadequate mixing and short-circuiting accentuated problems caused by variation in the wastewater BOD and/or phenol concentration. It was recommended that the return sludge be rerouted so that it entered the aeration basin in a common diffusion header with the wastewater feed. Conversion of the aerobic sludge digester to a second stage activated sludge aeration tank proved helpful. This was accomplished with piping and pumping modifications. (Baker-FRC)
W83-04086

FROM WASTEWATER TO DRINKING WATER,
Arber (Richard P.) Associates, Inc., Denver, CO.
R. P. Arber.
Civil Engineering (New York), Vol 53, No 2, p 46-49, 1983. 2 Fig.

Descriptors: *Water reuse, *Potable water, *Wastewater treatment, Drinking water, Water demand, Water supply development, Water resources development, Water supply, Reverse osmosis, Chlorination, Aeration, Filtration, Flocculation, Lime.

The Denver Water Department has embarked on a $29 million demonstration project to show the technical and economic feasibility of potable water reuse. The 1 million gallon per day demonstration plant produces potable water from sewage treatment plant effluent. Lime is added to unchlorinated effluent. Calcium carbonate forms in the rapid mix, becomes large particles in the slower mixing of the flocculation stage, then settles out in the lime clarification tank. Elevated pH levels from the lime treatment are reduced by adding carbon dioxide, which is acidic. The ballast pond is an equalization basin, taking the surges out of the flow caused by periodic backwashing of filters. A polymer and alum are added to help coagulate remaining solids, then flow is directed through filter media in dual pressure vessles of 0.5 mgd capacity each. Water is pumped to an ion exchange tank where zeolite removes ammonia. The zeolite must be periodically regenerated with a brine solution in a closed-loop stripping tower. A granular activated carbon filtration system, consisting of two carbon contactors with an ozonation chamber in between, removes residual organics. Carbon will be regenerated in a fluidized bed furnace. After the flow leaves the first contactor, 90% is piped directly to disinfection stage, then returned to the system as process water. Remaining 10% of the flow continues to final treatment stages, saving money on size of remaining process equipment. Reverse osmosis unit removes 90% of dissolved solids, aeration strips away dissolved gases and some volatiles, then chlorine dioxide is used as a disinfectant. Some of the resulting water will be tested for chemical composition and health effects on animals. (Baker-FRC)
W83-04099

ADSORPTION OF RADIUM-226 BY BIOLOGICAL ORIGIN ABSORBENTS,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
M. Tsezos, and D. M. Keller.
Biotechnology and Bioengineering, Vol 25, No 1, p 201-215, 1983. 7 Fig, 3 Tab, 22 Ref.

Descriptors: *Adsorption, *Radium, *Radioactive wastes, Biomass, Sludge, Wastewater treatment, Bacteria.

Adsorption of radium-226 from aqueous solutions was studied using waste microbial biomass from fermentation processes and municipal wastewater treatment plants. Radium uptake capacities (nCi per g) at pH 7 for 10, 50, and 300 pCi per ml Ra solutions were: Pseudomonas fluorescens, 0 to 20; Aspergillus niger, 12, 60, and 340; Streptomyces niveus, 32, 130, and 580; industrial sludge, 40, 230, and 1700; Rhizopus arrhizus, 140, 650, and 2000; municipal sludge B, 390, 1900, and 11,000; Penicillium chrysogenum, 450, 2100, and 12,000; municipal sludge A, 700, 5000, and 40,000; Darco S-51 activated carbon, 8, 26, and 120; and Filtrasorb 400 granular activated carbon, 26, 100, and 460. In general maximum uptake was between pH 7 and 10. Uptake was considerably reduced at pH 4 and almost absent at pH 2. (Cassar-FRC)
W83-04114

EFFECTS OF AMMONIA AND PHOSPHATE LIMITATION ON THE ACTIVATED SLUDGE TREATMENT OF CALCIUM-CONTAINING CHEMICAL WASTE,
Shell Development Co., Houston, TX.
J. P. Salanitro, P. T. Sun, and J. B. Thornton.
Biotechnology and Bioengineering, Vol 25, No 2, p 513-523, 1983. 4 Fig, 3 Tab, 20 Ref.

Descriptors: *Nutrients, *Calcium, *Chemical wastewater, Phosphates, Nitrogen, Ammonia, Activated sludge process, Wastewater treatment, Sludge solids, Settling velocity, Sludge volume index, Biomass, Bulking sludge.

The effects of ammonia and phosphate on the activated sludge treatment of a mixed chemical waste containing 1300 mg per liter of soluble Ca were studied in the laboratory. Four runs were made (high ammonia and phosphate, low ammonia and high phosphate, high ammonia and low phosphate, and low ammonia and phosphate). Ammonia levels (mg per liter) were 0.1 and 0.2 for the low treatments and 27 and 42 for the high treatments. Phosphate levels (mg per liter) were 0.1 for the low treatments and 2.4 and 4.2 for the high treatments. COD removal was 89-94%. CaC03 accumulation in biomass solids produced in the low phosphate treatments was 3800-3900 mg per liter

and 1800 mg per liter in the high phosphate treatments. The high-Ca sludges contained crystals of CaC03 and a high percentage of nonfilamentous bacteria; the low-Ca sludges contained filamentous and nonfilamentous bacteria. The high-Ca flocs had polysaccharide contents of 46-62 mg per g volatile suspended solids, sludge volume index of 10-12 ml per g, and settling velocity of 48 ft per hour. The low-Ca flocs had polysaccharide contents of 53-102 mg per g volatile suspended solids, sludge volume index of 60-87 ml per g, and settling velocity of 9-12 ft per hour. (Cassar-FRC)
W83-04115

THE INFLUENCE OF SALT CONCENTRATION ON THE HYDRAULIC PROPERTIES OF ION EXCHANGE RESINS,
Sybron Corp., Birmingham, NJ.
F. X. McGarvey, S. M. Ziarkowski, and B. Kiefer.
AIChE Symposium Series, Vol 78, No 219, p 74-82, 1982. 7 Fig, 13 Tab, 6 Ref.

Descriptors: *Hydraulic properties, *Brines, *Ion exchange, Backwash, Wastewater treatment, Resins, Specific gravity, Fluidized beds.

The hydraulic properties of ion exchange resins in salt solutions (10% and 20%), such as are used in secondary oil recovery, were studied. In a series of Ionac resins with 2% to 12.5% divinylbenzene (DVB) shrinkage was 1.7-49% in 10% salt solution and 5.2-58% in 20% salt solution; greatest shrinkage was in the 2% resin. Specific gravities of 4 mesh size cuts of an 8.5% DVB resin were: 1.2591-1.2789 in water; 1.2909-1.3221 in 10% NaCl; and 1.3265-1.3387 in 20% NaCl. Average C values for pressure drop were: water, 147; 10% salt, 152; and 20% salt, 156. Calculated flows at fluidization onset differed by 0.2-0.3 m per min for the -16+20 mesh size and an order of magnitude less in the other size ranges (-20+30, -30+40, -40+50) in water and salt solution. Bed expansion was greater in 20% brine than in 20% brine or water for a given flow rate. Differences increased with increasing flow rate. (Cassar-FRC)
W83-04132

BIOLOGICAL REGENERATION OF ACTIVATED CARBON,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemical Engineering.
D. A. Wallis, and E. E. Bolton.
AIChE Symposium Series, Vol 78, No 219, p 64-70, 1982. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Activated carbon, *Biological wastewater treatment, *Regeneration, Adsorption, Phenol, Wastewater treatment, Bacteria, Cultures.

The mechanisms of biological regeneration of spent activated carbon used in wastewater treatment were studied using Pseudomonas putida as the degrading microorganism and phenol solutions as indicators of regeneration. Phenol concentration in the feed (300 or 600 mg per liter) did not affect the concentration of adsorbed phenol after regeneration (31-34 mg per g activated carbon) or the % regeneration (49-53%). It was concluded that the microbial culture (1) maintains the solution concentration of phenol at a low level so that substrate desorption from the carbon will occur and (2) converts the phenol to nontoxic substances. The regeneration rate was about 25 mg phenol removed per g carbon per hour for adsorbed phenol concentrations of 40-65 mg phenol per g carbon. At lower concentrations regeneration was about 1 mg phenol per g carbon per hour, reflecting the decrease in the driving force for desorption of the phenol from the carbon as the adsorbed concentration decreased. The maximum extent of regeneration was related to the concentration of phenol in solution, implying that the regeneration rate approaches zero as the adsorbed phenol concentration approaches a state of equilibrium with the solution concentration. Adsorption capacity of the carbon was reduced by (1) carbon-culture contact beyond the maximum regeneration point and (2) multiple adsorption and regeneration cycles. (Cassar-FRC)
W83-04133

UNCERTAINTY ANALYSIS OF A COMPLEX REACTOR SYSTEM USING MONTE CARLO PROCEDURES,
Wayne State Univ., Detroit, MI.
R. H. Kummler, J. G. Frith, and C. -S. Liang.
AIChE Symposium Series, Vol 78, No 220, 36-48, 1982. 15 Fig, 6 Tab, 28 Ref.

Descriptors: *Combined sewer overflows, *Sensitivity analysis, *Model studies, Error analysis, Water quality, Wastewater treatment, Planning, Coliforms, Dissolved oxygen, Alternative planning, Detroit River, Rouge River, Detroit, Michigan, Urban areas, Monte Carlo method, Storm-overflow sewers, Sewer systems.

The combined sever overflow (CSO) system for the Detroit, Michigan, area was modeled, and alternative solutions for water quality problems in the Detroit and Rouge Rivers developed. Simulations included 26 different CSO control options varying from zero to 80 percent of existing overflow volumes. For the best alternative, fecal coliform counts in the Detroit River would be reduced 6-fold (from 240 to 42 per 100 ml) on an annual basis and 2-fold (529 to 252 hours) with respect to number of hours of standard violation. On the Rouge River the fecal coliform counts would be reduced from 1137 to 495 per 100 ml and the hours of violation from 2443 to 1808. It was recommended that no action be taken on the Rouge River section of the system and that several alternatives for the Detroit River section be subjected to cost-benefit analysis. Methods for determining the uncertainty produced by the hundreds of input parameters and the model assumptions included (1) an absolute first order error analysis of the Plume Model of the Detroit River, (2) an intercomparison of independent models of the Rouge River, and (3) a Monte Carlo analysis of the overall set of models. (Cassar-FRC)
W83-04134

THE EFFECT OF WATER PRETREATMENT CHEMICALS ON THE PERFORMANCE AND DURABILITY OF REVERSE OSMOSIS MEMBRANES,
California Univ., Los Angeles. Dept. of Chemical, Nuclear, and Thermal Engineering.
For primary bibliographic entry see Field 3A.
W83-04143

LOW ENERGY FILTRATION USING BUOYANT MEDIA,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
M. J. Semmens, S. Chiesa, P. Brezonik, and Y. Ming-Tang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105477, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Minnesota, St. Paul, August 1983. 35 p, 8 Fig, 39 Ref. OWRT A-046-MINN(1).

Descriptors: *Water treatment, *Wastewater treatment, *Filtration, Solids removal, Effluent polishing, Stormwater treatment, Upflow filtration, Energy, Low energy filtration.

The use of a spherical buoyant media in filtration has many potential advantages. The media stratify during backwashing such that the largest spheres are at the top of the bed and the smallest are at the bottom. During upflow filtration solids may be removed by both straining on the underside of the filter and by depth filtration. The accumulated solids may be readily dislodged by a brief downflow backwash and gravity assists in this cleaning process. Basic studies on the removal of coagulated clay suspensions indicated that the clay was removed throughout the depth (D.3m) of the filter for media sizes between 0.6 and 1.0 mm. Straining was not observed to be significant but it would become more important for smaller media sizes or more flocculant solids. Headloss development was monitored and followed the expected behavior for depth filtration. Low headlosses could be maintained by using shallow bed of media and backwashing frequently. These preliminary studies indicate that if the buoyant media are to be used in an effective low energy filter, the system design will be very important. A straining mechanism may be preferred since the solids are retained on the underside of the filter and gravity will assist in cleaning the bed during backwash. However, to avoid rapid headloss development depth filtration must be used also. Additional studies are needed to characterize the backwashing behavior of the media and to identify the best operating strategies for long-term use.
W83-04149

TREATMENT OF RECYCLE STREAMS FROM THERMAL SLUDGE CONDITIONING,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
R. R. Dague.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105592, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report No 121, Iowa State Univ., Ames, March 1983. 43 p, 17 Fig, 6 Tab, 26 Ref. OWRT A-073-IA(1), 14-34-0001-0117.

Descriptors: *Biological wastewater treatment, *Biological filter, Anaerobic bacteria, Wastewater treatment, *Sludge conditioning, *Thermal sludge, *Iowa, Anaerobic filter, Sludge treatment.

The thermal conditioning and dewatering of activated sludges in wastewater treatment plants results in decant and filtrate streams that are high in organic matter. Although the volume of the recycle flow is small, the high strength may add as much as 20% or more to the total organic load on the treatment plant. The purpose of this research was to evaluate the impact of the recycle of the high-strength waste streams on plant performance in terms of increased oxygen consumption and sludge production, and to determine the effectiveness of the anaerobic filter in treating the recycle flow from thermal sludge conditioning. Thermal conditioning wastes from Dubuque, Iowa, had an average 5-day BOD of 9,600 mg/L and a Bd exertion rate of 0.2063 per day (base 10). This indicates an ultimate to 5-day BOD ratio of 1.1. The application of the anaerobic filter to the Dubuque thermal conditioning wastes indicated that a 20-day BOD removal of 84% could be achieved with a filter eight feet in depth and loaded at a nominal 200 lb of BOD sub 20/1000 cu ft of filter volume. When applied to the thermal conditioning wastes from Cedar Rapids, Iowa, similar results were obtained. The recycle of thermal conditioning wastes at Dubuque increased the BOD sub 5 load on the plant by 20.0% of the total plant influent BOD sub 5. Treatment of the thermal conditioning liquor with an anaerobic filter to an 85% BOD sub 20 removal level would reduce this increase to only three percent. It is concluded that the anaerobic filter is an effective way of treating the high strength waste from thermal conditioning processes, resulting in significant reductions in oxygen consumption and excess sludge production in activated sludge wastewater treatment plants.
W83-04161

TREATABILITY STUDIES ON LEACHATE FROM A CO-DISPOSAL LANDFILL,
Cleanaway Ltd., Rayleigh (England).
K. Knox.
Environmental Pollution, Series B, Vol 5, No 3, p 157-174, 1983. 7 Tab, 9 Ref.

Descriptors: *Leachates, Ammonia, *Biological treatment, Organic carbon, *Landfills, *Waste disposal, *Aerobic treatment, Industrial wastes, Hazardous materials, Nitrification, Fermentation, Activated carbon, Color, Waste dumps, Lime, *England, South Essex, *Wastewater treatment.

Characteristics of leachate from the Pitsea landfill, a major co-disposal site in South Essex, England, are presented. The leachate typifies a stabilized situation where acid fermentation is in balance with methane formation. No hazardous wastes were detected in the leachate. Although aerobic biological treatment was capable of completely nitrifying the ammonia in the leachate, it was unable to effectively remove organic carbon. Lime

treatment removed a high proportion of the colored compounds from the leachate, but only 20% of the organic carbon. Powdered activated carbon removed both color and organic carbon. The removal of total organic carbon conformed to a Freundlich-type isotherm. Toxicity tests showed that ammonia was the only toxic substance in the leachate requiring removal. Conventional biological methods were sufficient to treat the landfill leachate. (Geiger-FRC)
W83-04172

FACTORS AFFECTING THE CLARIFICATION PERFORMANCE OF ACTIVATED SLUDGE FINAL SETTLERS,
Chulalongkorn Univ., Bangkok (Thailand). Dept. of Sanitary Engineering.
M. Tuntoolavest, E. Miller, and C. P. L. Grady, Jr.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 234-248, March, 1983. 7 Fig, 7 Tab, 23 Ref.

Descriptors: *Wastewater treatment, *Clarification, Clarifiers, Aeration basins, Wastewater treatment facilities, Sludge, *Activated sludge processes, *Settlers, Design criteria, Quality control.

Factors which affect the clarification performance of pilot plant settlers were examined. Of the three operational variables studied, mixed liquor suspended solids concentration (MLSS), air flow rate, and sludge recycle ratio, the MLSS concentration had the strongest effect on the effluent suspended solids concentration. Effluent quality deteriorated as the MLSS concentration increased, confirming the results of an earlier study by Pflanz. The other operational variables exerted less significant effects on the effluent suspended solids concentration, although the turbulence level caused the greater effect of the two and there was a complex interaction between them. Because of the complex interaction between the sludge recycle ratio and the turbulence level, the MLSS concentration is the only easily manipulated control variable available for short-term control of the effluent suspended solids concentration. These findings were consistent with the concept that floc breakup predominates over floc formation in an activated sludge aeration chamber. The quality of effluent leaving an activated sludge settler is determined largely by the amount of dispersed solids entering the settler. The effects of settler overflow rate and retention time were of about the same magnitude, although both had less effect than the MLSS concentration. Because of the effects of MLSS concentration and turbulence level on the concentration of suspended solids in the effluent from an activated sludge settler, it is likely that least-cost designs will call for low MLSS concentrations and large aeration basins. (Baker-FRC)
W83-04177

HEAT RECOVERY, FLOW EQUALIZATION, AND ALTERNATE DISCHARGE HIGHLIGHT AWT EXPANSION,
Black and Veatch, Denver, CO.
G. F. Shimp, G. E. Berg, S. A. Swanson, and G. Brown.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 249-254, March, 1983. 6 Fig.

Descriptors: *Wastewater treatment facilities, *Design criteria, *Advanced wastewater treatment, Breckenridge Sanitation District, Water quality control, Flow, Colorado, Phosphorus removal, *Heat exchangers.

The series of management actions and facility improvements that enabled the Breckenridge Sanitation District to maintain compliance with water quality standards while providing for continued growth in its service area are described. Specific goals in developing the plant expansion design included making maximum practical use of the facilities in the existing treatment plant; improving process stability and overall plant operability; improving treatment performance in critical areas; providing improved sludge stabilization and processing facilities consistent with the countywide sludge management plan; and improving the energy efficiency of the treatment operation, where practical. Unique features involved in the expansion of the advanced wastewater treatment plant which were necessitated due to site-specific problems included the accomplishment of flow equalization inline without pumping, aeration, or mixing. New facilities were to be selectively incorporated into the treatment train to achieve maximum use of existing facilities. Common-wall construction and covered basins will be used where possible in the new treatment additions to reduce building heating requirements. A heat pipe heat exchanger will be used to recover heat from the aerobic digesters, and the plant's discharge will be relocated to avoid an ammonia toxicity problem. (Baker-FRC)
W83-04178

NITRIFICATION FACILITIES START-UP AND INITIAL OPERATION,
District of Columbia Dept. of Environmental Services, Washington. Wastewater Div.
W. F. Bailey, J. D. Bonomo, and E. R. Jones.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 221-228, March, 1983. 6 Fig, 3 Tab, 6 Ref.

Descriptors: *Wastewater treatment facilities, *Nitrification, Wastewater treatment, Economic aspects, Aeration, Biochemical oxygen demand, Nitrogen, Kjeldahl nitrogen, Phosphorus, District of Columbia, *Advanced wastewater treatment.

Expansion of the District of Columbia's wastewater treatment plant at Blue Plains has been underway since 1970. At a cost of over $450 million, the plant was upgraded from a modified aeration secondary treatment plant to an advanced wastewater treatment facility capable of achieving over 95% removal of suspended solids, 5-day biochemical oxygen demand, total Kjeldahl nitrogen, and total phosphorus. The systematic training and start-up efforts required to place this large, complex facility in service are discussed. The first year's operating and process control data for the nitrification system are presented. The systematic approach contained several elements, starting with the division of the overall start-up into numerous manageable task groups, then proceeding with work on each group simultaneously. A start-up coordinating committee was formed to oversee the overall program, ensuring that all activities were complete. Along with other tasks this committee planned and implemented a comprehensive and site-specific training program during the start-up of a major process at an existing wastewater treatment facility. After an initial period of satisfactory operation, the nitrification process became upset, with decreased settleability and TKN removal. This was followed by improved performance and compliance with effluent quality requirements, indicating that reduction of nitrification rate may occur as the influent BOD5:TKN ratio is increased; the mean alkalinity destroyed:TKN removal for the entire year was 5.3 g/g, which was significantly lower than the theoretical value; and the nitrification rate and system stress data may be used effectively for process control, particularly when coupled with other measurements of mixed liquor quality. As stress increased above the maximum level, effluent TKN concentration increased sharply. (Baker-FRC)
W83-04179

TEMPERATURE EFFECTS ON OXYGEN TRANSFER TO ROTATING BIOLOGICAL CONTACTORS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittmann, R. Suozzo, and B. R. Romero.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 270-277, March, 1983. 9 Fig, 2 Tab, 21 Ref.

Descriptors: *Rotating biological contactors, *Temperature effects, *Wastewater treatment, Oxygen transfer, Oxygen, Biochemical oxygen demand, Nitrification, Denitrification, Methanogenesis.

Successful scale-up or transfer of rotating biological contactors (RBCs) technology from pilot scale to full scale, from one wastewater to another, and from one loading condition to a second loading condition requires an understanding of the rate-controlling mechanism. A laboratory scale RBC, in which nine flat disks of 50 cm diameter rotate in a basin of water, was constructed from polymethyl methacrylate. For certain experiments, the disks were not rotated. Instead, a propeller-mixer was inserted into the basin and used to produced a mixing pattern in the basin without withdrawing a liquid film on the disks. These mixer experiments allowed determination of the mass transfer produced solely by agitating the surface of the liquid in the basin. It was noted that as the rotation speed was increased, the overall mass transfer coefficient was increasingly dominated by oxygen transfer via the liquid film that adhered to the rotating disks. For the typical tip speed used in practice, 20 m/min, the film transfer was responsible for about 75% of the total oxygen transfer for the laboratory scale unit. The temperature correction factor was not a constant. Temperature did affect the dominant mechanism. Higher temperatures produced slightly higher temperature-correction factor values because direct transfer became more dominant. The overall oxygen transfer rates were lower at higher temperature than at low temperature. Analysis of the oxygen-transfer mechanisms leads to the prediction that larger units will have a lower oxygen transfer rate than a smaller unit having the same tip speed and specific surface area. (Baker-FRC)
W83-04181

BACTERIAL DIE-OFF KINETICS IN WASTE STABILIZATION PONDS,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
C. Polprasert, M. G. Dissanayake, and N. C. Thanh.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 285-296, March, 1983. 7 Fig, 6 Tab, 32 Ref.

Descriptors: *Stabilization ponds, *Wastewater treatment, *Bacteria, *Kinetics, Mathematical equations, Temperature effects, Algae, Model studies, Brazil.

Waste stabilization ponds (WSP) are becoming popular for treating wastewater, particularly in tropical and subtropical regions where there is normally and abundance of sunshine, and the ambient temperature is high. A research program was undertaken to develop mathematical relationships of the baterial die-off in WSP incorporating two proposed models, one for the algal concentration Cs and the other for the bacterial die-off rate coefficient. A multiple linear regression equation was developed to relate the bacterial die-off rate coefficient, k, to other parameters. This equation can be extended to predict the k values of other baterial species by the introduction off the species coefficients into the regression coefficient. The non-ideal flow equation of Wehner and Wilhelm was proposed for the prediction of the bacterial survival ratio in WSP. Besides the k value, this equation accounts for the pond dispersion factor, d, and the actual hydraulic detention time. The Wehner and Wilhelm equation yielded better results in predicting bacterial die-off in WSP than the first-order rate equation. This is probably because the former includes other important parameters influencing pond performance and bacterial die-off. Verification of the model responses was made with data of the full scale WSP and some ponds in northeast Brazil. Sensitivity analyses were carried out to show the effect that changes in magnitude of these influential parameters had upon the k values and the bacterial survival ratio. (Baker-FRC)
W83-04182

VELOCITY AND SUSPENDED SOLIDS DISTRIBUTION IN SETTLING TANKS,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
A. Joo-Hwa Tay, and G. W. Heinke.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 261-269, March, 1983. 12 Fig, 6 Tab, 17 Ref.

Descriptors: *Wastewater treatment, *Suspended solids, *Settling tanks, *Settling velocity, Hydraulic loading, Phosphorus removal.

Data and analysis and presented on measurements of velocity and suspended solids concentrations inside two primary settling tanks and one pilot plant. The plants were operated at varying rates of hydraulic loading with and without the addition of chemicals of phosphorus removal. The investigations covered a period of 3 years. Velocity measurements inside a settling tank were deemed to be useful tools in predicting the reduction of suspended solids in a settling tank. An instrument that allows velocity measurements in three directions, and down to a few millimeters per second, is required. Local velocities are the main factor influencing the settling of physical or physical-chemical flocs. For raw domestic wastewater, velocities should be kept below 15 mm/sec to achieve about 50% removal suspended solids. The influence of increasing flow rates, resulting in correspondingly higher velocities, on the reduction of suspended solids is greater for raw wastewater than for chemically treated wastewater, particularly when polymers are used. For the settling tanks studied, maximum velocities generally occurred between a 0.4 and 0.8 fraction of the depth of the tank. For each tank the velocity profile pattern did not change significantly with increasing flow rate, although the magnitude did of course increase. A mathematical model was developed, through modification of an existing model used in air pollution studies, which allows the prediction of suspended solids levels in the tanks. This may be useful in the future. (Baker-FRC)
W83-04183

INACTIVATION OF SALMONELLA DURING ANEROBIC DIGESTION OF SEWAGE SLUDGE,
Water Research Centre, Stevenage (England).
E. G. Carrington, S. A. Harman, and E. B. Pike.
Journal of Applied Bacteriology, Vol 53, No 3. p 331-334, 1982. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Salmonella, *Anaerobic digestion, *Kinetics, Digested sludge, Digestion, Sludge digestion, Sewage bacteria, Retention time, Temperature.

The inactivation of Salmonella duesseldorf in sewage sludge during anaerobic digestion of spiked raw sewage sludge was studied at 35 and 48 degrees with mean retention periods between 10 and 20 days. Specific rates of decay were greater at the higher temperature for the same retention times and similar for retention periods greater than 15 days but lower for 10 day retention periods. The rates of decay were greater when levels of Salmonella in the feed were lower. Gas production, an indicator of the steady state, was reduced with a mean retention period of 6.7 days. When a single dose of the bacterium was added to the digesting sludge, the inactivation period appeared to follow first-order kinetics at 35 degrees, and the decimal decay rate was similar to that in the daily feeding regime with larger and similar inocula levels. At 48 degrees, the rate of inactivation decreased with decreasing time from inoculation, suggesting that cells of different thermal resistance were present in the culture. Rates and degrees of inactivation in such experiments are greater than in full-scale digesters because the indigenous Salmonellae of the latter are more resistant and conditions are seldom ideal for inactivation. (Geiger-FRC)
W83-04184

EFFECT OF DIFFUSIONAL RESISTANCES ON THE PERFORMANCE OF SUBSTRATE INHIBITED IMMOBILIZED ENZYMATIC CFSTR SYSTEMS,
University of Petroleum and Minerals, Dhahran (Saudi Arabia).
S. Ilias, S. A. Beg, and M. M. Hassan.
Journal of Environmental Science and Health, Part A, Vol 18, No 2, p 311-326, 1983. 6 Fig, 28 Ref.

Descriptors: *Mathematical models, *Wastewater treatment, *Enzymes, *Diffusion coefficient, *Membrane processes, Model studies, Flow resistance, Mathematical studies.

Recent developments in large scale enzyme purification have resulted in the development of various techniques for the immobilization of enzymes for application in industry, medicine and waste treatment. A single particle diffusion model is presented for estimating an effectiveness factor for a substrate inhibited encapsulated immobilized enzyme particle of spherical shape. The model takes into account both internal and external diffusional resistances and may be applied to the performance of a continuous flow stirred tank reactor (CFSTR) system. The effects of membrane thickness, Sherwood Number, dimensionless inhibitor constant, characteristic CFSTR-encapsulated enzyme particle parameter, and the ratio of the substrate diffusion coefficients on the substrate conversion are studied parametically. Numerical results are given for a range of variables of practical importance. (Geiger-FRC)
W83-04187

OPTIMISED AEROBIC AND THERMOPHILIC TREATMENT OF MUNICIPAL SEWAGE SLUDGES AND NIGHT SOILS IN A CONTINUOUS OPERATION,
PLM Resource Recovery Div., Malmo (Sweden).
C. -G. H. Carlson.
Journal of Chemical Technology and Biotechnology, Vol 32, No 11, p 1010-1015, 1982. 6 Fig, 2 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Aerobic digestion, *Biodegradation, *Aeration, *Optimization, Sludge drying, Digestion, Sludge digestion, Digested sludge, Biological oxygen demand, Mixing.

Aerobic and thermophilic (57 degrees) biodegradation and stabilization processes were applied to a thick homogenized feed of 5-7% dry solids from raw and partly digested municipal sludges and night soils at a commercial wastewater treatment center. Kinetic data for biodegradation were optimized with respect to mixing and aeration. Graphs were generated, from which optimal retention time and other process stage parameters were calculated to achieve a BOD7 reduction of 85%. The prime feeds for raw and partially digested sludges were 10-15% for dried solids (DS) in a pH range of 6.5-7.2 at a BOD7 of 35-52 g/kilogram. For night soils and feces, the prime feeds were 1-2% DS in a pH range of 6.7-7.4 at a BOD7 of 6.5-14 g/kilogram. Costs for BOD removal in the optimized process are less than with conventional techniques for waste and sludge treatment, and the enzyme treated dewatered effluents are acceptable for land infiltration. (Geiger-FRC)
W83-04198

5E. Ultimate Disposal Of Wastes

COAL CONVERSION SOLID WASTE DISPOSAL,
Oak Ridge National Lab., TN.
C. W. Francis, W. J. Boegly, Jr., R. R. Turner, and E. C. Davis.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1301-1311, December, 1982. 2 Fig, 4 Tab, 13 Ref.

Descriptors: *Solid waste disposal, *Land disposal, *Landfills, *Leachates, *Coal gasification, *Fly ash, Solid wastes, Industrial wastes, Hazardous materials, Groundwater pollution, Sulfates, Water pollution sources.

Extensive characterization and leaching studies were carried out on ash slags generated in bench scale operations, pilot plants, and/or process development units for eight different gasification processes to assess the consequences of disposal in landfills. None of the eight wastes exceeded the United States Environmental Protection Agency's toxicity limits set forth in the Resource Conservation and Recovery Act of 1976, and they were therefore classified as nonhazardous wastes. Concentrations of polynuclear aromatic hydrocarbons in the aqueous leachates of selected ash slags were less than 1 microgram/gram and posed no significant environmental threat. For wastes containing sulfur concentrations of 0.3-4%, column elution studies produced effluents with pH values less than 3 and sulfate concentrations greater than 10,000 milligrams/liter. Therefore the major environmental impact associated with the land disposal of these ash slag wastes may be the dissolution of sulfates and the potential acidification of groundwaters. (Geiger-FRC)
W83-03858

DECOMPOSITION OF SOLID WASTE IN TEST LYSIMETERS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
R. K. Ham, and T. J. Bookter.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1147-1170, December, 1982. 8 Fig, 4 Tab, 3 Ref.

Descriptors: *Lysimeters, *Land disposal, *Landfills, *Leaching, *Solid waste disposal, Waste disposal, Leachates, Evapotranspiration, Chemical oxygen demand, Methane, Municipal wastes, Runoff rates, Water pollution sources.

Eight lysimeters designed to test the effects of refuse shredding, soil cover, and lift thickness were filled with 100 or 200 tons of residential and light commercial solid wastes and were monitored for seven years for leachate and runoff rates, gas and leachate composition, and refuse temperature and surface settlement. With soil cover, more runoff but less evapotranspiration was observed, so that leachate rates were about the same with or without soil cover. When landfilled under similar conditions, shredded refuse produced higher peak concentrations of matter in leachate than unprocessed refuse. Without soil cover, leachate strengths declined rapidly after reaching peak concentrations, with the result that shredded refuse without cover produced less chemical oxygen demand (COD) than either shredded or unprocessed covered refuse. Doubling the refuse depth nearly doubled the leachate COD levels, but greatly increased the stabilization time needed to attain low COD levels. Placement of a second lift of refuse over a relatively well stabilized first lift reduced COD produced by the second lift by 75-99%. Two cells without soil cover and with unprocessed refuse had lower leachate containment and lower methane gas levels, but presented problems with odor, flies and rodents. (Geiger-FRC)
W83-03861

EFFECT OF SEWAGE SLUDGE ON TRACE ELEMENT MOBILITY IN SOILS,
Institute for Soil Fertility, Groningen (Netherlands). Dept. of Soil Biology.
For primary bibliographic entry see Field 5B.
W83-03893

HEAVY METAL CONCENTRATIONS IN EARTHWORMS FROM SOIL AMENDED WITH SEWAGE SLUDGE,
Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center.
For primary bibliographic entry see Field 5B.
W83-03897

NITROGEN AND PHOSPHORUS MOVEMENT IN COMPOST-AMENDED SOILS,
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W83-03898

EFFECTS ON SOILS AND VEGETATION OF PLANT NUTRIENTS AND HEAVY METALS FROM WASTEWATER-TREATMENT-PLANT SLUDGES DISPOSED ON LAND,
West Virginia Univ., Morgantown. Water Research Inst.
D. J. Horvath, R. F. Keefer, and R. N. Singh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255463, Price codes: A06 in paper copy, A01 in microfiche.

Completion Report August 1983. 123 p, 9 Fig, 68 Tab, 77 Ref, 1 Append. OWRT A-025-WVA(3), 14-34-0001-7104.

Descriptors: *Environmental effects, Food chains, Heavy metals, *Land disposal, *Nutrients, *Phytotoxicity, *Sludge disposal, Soil contamination, Trace elements, *Waste disposal, *Water pollution sources, Cadmium, Chromium, Ecology, Nickel, Nitrogen, Path of pollutants, Phosphorus, Plant growth substances, Toxicity, Wastewater disposal, Wastewater pollution, *West Virginia.

Sludges and effluents from wastewater-treatment-plants in West Virginia cities were analyzed chemically for fourteen elements. By greenhouse and field applications to corn and soybean crops, sludges were evaluated for effectiveness in providing plant nutrients and in introducing heavy metals into the food chain. Effluents contained a higher proportion than sludges of the elements except iron, copper, zinc, and lead. Plant nutrients, especially nitrogen and phosphorus, occurred in amounts beneficial to plant growth. Toxic manganese levels in soils were reduced by sludge application. No toxocity or undesirably high levels of copper, zinc, chromium, nickel, or lead were found, but cadmium was increased sufficiently to cause concern. Use of lime and phosphorus fertilizer retarded heavy-metal absorption by the crop plants. Nutrients and heavy metals were restricted to upper soil horizons. Except for nickel, heavy metals did not accumulate in plant tissues unless sludge-application rates were very high. Soybean tissues at one site absorbed nickel from a sludge not extraordinarily high in nickel but not from another sludge extremely high in nickel. The sludges caused no evident phytoxicity. Cadmium is the only one of these elements that could cause alarm by accumulating to toxic levels in plants grown on sludge-amended soils.
W83-03905

AN ANALYTICAL MODEL OF CONTAMINANT MIGRATION IN SHALLOW AQUIFERS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W83-03909

AGRICULTURAL DISPOSAL OF SLUDGES ON A HISTORIC SLUDGE DISPOSAL SITE,
Severn-Trent Water Authority (England). Lower Trent Div.
H. Rundle, M. Calcroft, and C. Holt.
Water Pollution Control, Vol 81, No 5, p 619-632, 1982. 4 Fig, 17 Tab, 21 Ref.

Descriptors: *Sludge disposal, *Metals, *Land application, Fate of pollutants, Cadmium, Zinc, Heavy metals, Land disposal, Stoke Bardolph Estate, Nottingham, *United Kingdom, Arming.

Sewage and sludge have been applied to the 800 ha Stoke Bardolph estate near Nottingham, England, since 1880. Results of a soil survey performed in 1977 showed that Zn levels are greater than the ADAS recommended 250 mg per kg limit on 100% of the estate. The ADAS levels are exceeded for Cd on 71% of the area, for Cr on 35% of the area, and for Pb on 4% of the area. An 8 ha section has very high heavy metals concentrations (8000 mg per kg Zn and 45 mg per kg Cd), a result of disposal of sludges from insufficiently treated industrial effluents. Zn and Cd levels projected for the year 2014, assuming the present rates of sludge application, would rise to maxima of 11,000 mg per kg Zn and 65 mg per kg Cd. The total area exceeding the ADAS recommended levels is expected to increase slightly. This farm currently grows grass, maize, cereals, and dairy cattle. Levels of heavy metals and nitrates are regularly monitored to prevent sale and consumption of products too high in toxic substances. It was estimated that 540 kg per year of Cd is applied in sludge. Of this, 6.4 g per year may enter the human food chain. (Cassar-FRC)
W83-03945

RE-USE OF SLUDGES AND TREATED WASTE WATER IN AGRICULTURE. (TROUBLES ARISING FROM THE CONTAMINATION OF SOILS WITH HEAVY METALS AND FROM APPLICATION OF SLUDGES AND TREATED WASTE WATER IN AGRICULTURE),
Biologische Bundesanstalt fuer Land- und Forstwirtschaft, Berlin (Germany, F.R.). Inst. for Non-Parasitic Plant Diseases.
A. Kloke.
Water Science and Technology, Vol 14, No 12, p 61-72, 1982. 3 Fig, 6 Tab, 10 Ref.

Descriptors: *Fate of pollutants, *Land application, *Sludge disposal, Sludge, Agriculture, *Heavy metals, Cadmium, Lead, Mercury, Plants, Uptake, Guidelines, *Federal Republic of Germany, *Treated water.

Since plants, including those used for food, take up and accumulate increasing amounts of heavy metals with increasing amounts of these hazardous elements in the soil, it is necessary to establish tolerable amounts of heavy metals in soil. In order to determine what is safe and what is hazardous in the line of tolerable amounts of heavy metals in foodstuffs, one must note the toxicological considerations of the FAO/WHO Expert Committee on Food Additives, presented in 1972. This group set forth recommended preliminary amounts for tolerable weekly intake of lead, cadmium, and mercury. These are used as starting points of consideration and calculation for the upper limits of these elements in individual foodstuffs, including plants. Heavy metals enter the soil through different routes and are slowly accumulated there. If the input of pollutants is stopped their concentration in soil does not decrease. The heavy metals contents of plants depend not only on the amount present in soil but also on the plant species. Analysis of heavy metals in soil and plants is tedious and time-consuming, and large mean errors are common. Studies of potential harm to future generations are underway in the Federal Republic of Germany in order to establish limits to the amounts of sludge or wastewater which may be disposed of by land application. Tentative limits have been established by the German government for heavy metals in soils and sludges, ranging from 3000 mg/kg dry matter in sludge and 300 mg/kg in soil for zinc to 25 and 2 mg/kg, respectively, for mercury. Once the corresponding soil level has been reached, land application must cease. (Baker-FRC)
W83-03970

COMPARATIVE MOVEMENT OF DIFFERENT ENTEROVIRUSES IN SOIL COLUMNS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 5B.
W83-03984

IRRIGATION WITH SIMULATED SECONDARY WASTE WATER ON TILED SOIL CROPPED TO BROMEGRASS AND CORN,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 3C.
W83-03985

DISPOSAL OF FEEDLOT-LAGOON WATER BY IRRIGATING BROMEGRASS: II. SOIL ACCUMULATION AND LEACHING OF NITROGEN,
Kansas Agricultural Experiment Station, Manhattan. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W83-03986

MINERALOGICAL CONTROLS ON TOXIC ELEMENT CONTAMINATION OF GROUNDWATER FROM BURIED ELECTRICAL UTILITY SOLID WASTES: I. SOLID WASTE MINERALOGY II. LITERATURE REVIEW OF FLY ASH MINERALOGY,
North Dakota State Univ., Fargo.
For primary bibliographic entry see Field 5B.
W83-04004

FLOW OF KAOLINITE AND SEWAGE SUSPENSIONS IN SAND AND SAND-SILT: I. ACCUMULATION OF SUSPENSION PARTICLES,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
R. L. Uebler, and D. Swartzendruber.
Soil Science Society of America Journal, Vol 46, No 2, p 239-244, March/April, 1982. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Clogging, *Filtration, Suspended solids, Mathematical equations, *Kaolinite, *Sand, Silt, Laboratory studies, *Waste disposal, Land disposal.

Following application of laboratory sewage and kaolinite suspensions, the contents of water and accumulated suspension solids were measured both nondestructively and simultaneously at highly localized positions in vertical columns of sand and sand-silt using the dual-energy gamma-ray apparatus of Nofziger and Swartzendruber. The results were compared with a proposed mathematical description of the clogging process. The attenuation technique was successful for measuring the kaolinite bulk density but was of limited value for determining the sewage-solid bulk density. By postulating mechanism of suspension particle entrapment within the porous medium, an exponential equation was derived to describe the accumulation of suspension particles with time at a fixed position. The constants in this equation were determined from the experimental data by nonlinear least-squares regression and appeared to offer promise for characterizing the kaolinite accumulation in the sand and sand-silt. In general, the maximum accumulation of kaolinite occurred in the several millimeters nearest the suspension application surface. The initial water content had little effect on Kaolinite accumulation in the sand-silt. A depth of penetration to about 16 cm was detected in the initially air-dry sand; the maximum accumulations were larger than in the sand-silt but required much more time to attain. (Baker-FRC)
W83-04068

FLOW OF KAOLINITE AND SEWAGE SUSPENSIONS IN SAND AND SAND-SILT: II. HYDRAULIC CONDUCTIVITY REDUCTION,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
D. Swartzendruber, and R. L. Uebler.
Soil Science Society of America Journal, Vol 46, No 5, p 912-916, September/October, 1982. 6 Fig, 1 Tab, 14 Ref.

Descriptors: Flow, Permeability coefficient, Soil water, *Solute transport, *Kaolinite, Sewage, Land disposal, *Sludge disposal, *Sand, *Silt, Clogging, Filtration, Mathematical equations.

The reduction of hydraulic conductivity during the flow of kaolinite and sewage suspensions was analyzed. A theoretical equation for hydraulic conductivity behavior was derived, and was confirmed by laboratory experiments with sewage effluent and kaolinite suspension flowing through columns of sand and sand-silt. In the equation hydraulic conductivity is expressed as an exponential function of the cumulative volume of suspension inflow; the equation contains a characterizing constant, termed the clogging coefficient, which is zero when water alone is the flow liquid. The equation was verified by experimental measurements. For a given suspension, the clogging coefficient was larger for sand-silt than for sand; that of a given porous medium was larger for kaolinite suspension than for sewage suspension, but was not significantly affected by the initial water content (air-dry or satiated) of the porous medium. The clogging coefficient offers promise as a criterion for the design of land application sewage systems and as a parameter for describing soil crusting caused by the infiltration of muddy water. (Baker-FRC)
W83-04069

EPA'S NEW LAND DISPOSAL RULES-A CLOSER LOOK,
A. Morrison.
Civil Engineering (New York), Vol 53, No 1, p 44-49, 1983. 5 Fig.

Descriptors: *Waste disposal, *Regulations, *Groundwater protection, Groundwater contamination, Monitoring, Leachates, Hazardous wastes, Land disposal, Waste dumps, Waste Storage, Environmental Protection Agency, Linings.

The new land disposal rules of the EPA represent a two-pronged approach: design and operating standards intended to minimize leachate generation in the facility and leakage out of it; and a groundwater monitoring and remedial response program to detect and clean up any ground water contamination. The rules call for broad use of groundwater monitoring to detect leaks, in most cases after a plume of leachate has entered the groundwater. Four types of facilities are covered in the regulations: landfills, surface impoundments, waste piles, and land treatment units. Major features of the regulations include: a synthetic membrane liner and a leachate collection and removal system for new landfills; new surface impoundments and waste piles must install a liner which may be synthetic or clay; the groundwater monitoring and response requirements established a three-tiered program to detect, evaluate and correct groundwater contamination during the active life of the unit; existing portions of landfills, impoundments, and waste piles are exempt from the liner and leachate collection requirements, facilities with two synthetic liners are exempt from the groundwater monitoring requirement; any facility closed without first removing or decontaminating a hazardous material must have a final cover or cap; and variances from the liner and leachate collection rules will be allowed if the owner/operator can prove to EPA that wastes will never escape the unit. (Baker-FRC)
W83-04100

LINING A POND TO CONTAIN URANIUM TAILINGS,
R. D. Baldwin.
Civil Engineering (New York), Vol 53, No 1, p 77-79, 1983. 1 Fig.

Descriptors: *Waste storage, *Ponds, Evaporation, Uranium, Sulfuric acid, Hazardous wastes, Linings.

Impermeable pond linings combined with fabric underlinings are a recent innovation in industrial storage pond construction. In 1980 three such ponds were built to provide 71 acres for effluent storage and evaporation at a uranium mill. The process of refining uranium ore into the industry standard yellowcake requires use of sulfuric acid as leaching agent. The stored waste material therefore contains both spent sulfuric acid and some uranium in solution. This pond lining effectively contained the liquid and protected the groundwater supplies below. Evaporation leaves a more concentrated solution which is then recycled for some additional recovery of uranium values. The latest ponds at the Anaconda site have no layer of earth on top of the pond liner. Without this earth layer the liner can be inspected routinely and repairs performed when needed. One method of eliminating wave action problems encountered in storage ponds has been to use smaller ponds as wave action is proportional to the reach across the pond. The liner itself which has been used is a three ply laminated industrial grade reinforced Hypalon produced by duPont. Two calendered 15 mil thicknesses of Hypalon encapsulate one layer of high strength polyester woven fabric scrim to produce a single nominal 36 mil thickness laminated product. Fibretex was used as a geotextile underlining. Properly installed it is unaffected by ultraviolet light, acids, alkalies,oils and most chemical solvents. It resists tearing, puncture and abrasion. Filling the new ponds began eleven months after the start of the project. The cost was $60,000 per acre, including earthwork, Fibretex, Hypalon, installation, testing and quality control. (Baker-FRC)
W83-04101

TREATABILITY STUDIES ON LEACHATE FROM A CO-DISPOSAL LANDFILL,
Cleanaway Ltd., Rayleigh (England).
For primary bibliographic entry see Field 5D.
W83-04172

PHYSICAL DESIGN OF OVERLAND FLOW SYSTEMS,
California Univ., Davis. Dept. of Civil Engineering.
R. G. Smith, and E. D. Schroeder.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 255-260, March, 1983. 5 Fig, 21 Ref.

Descriptors: Wastewater treatment, *Overland flow, *Land application, Land disposal, *Wastewater disposal, *Design criteria.

Overland flow processes are rapidly gaining acceptance for the treatment and disposal of municipal wastewaters. This paper reviews problems and suggests solutions along with design criteria currently in vogue for physical components of such systems. Physical design considerations must examine slope grade, slope length, distribution systems available, top of slope systems, distributed application systems, and runoff collection systems. Overland flow processes can provide inexpensive solutions to municipal wastewater treatment problems. Problems observed in systems now operating result in lower than expected effluent quality and higher than predicted maintenance costs. Significant design problems can be caused by viewing these complex processes as simple or as similar to temporary agricultural irrigation systems. (Baker-FRC)
W83-04180

SLUDGE RECYCLE AND REUSE IN ACID MINE DRAINAGE TREATMENT,
Nebraska Univ. at Omaha. Dept. of Civil Engineering.
G. B. Keefer, and W. A. Sack.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 278-284, March, 1983. 3 Fig, 11 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Sludge disposal, *Acid mine drainage, *Activated sludge process, Ferric sulfate, Sulfates, Iron.

The production of acid mine drainage and the associated waste sludge produced from lime neutralization of AMD are increasing in the Appalachian region. Research was undertaken to make more efficient use of the lime used in the AMD neutralization process; to investigate recovery of the iron in the AMDS for use as a coagulant; to reduce the ultimate volume of the AMDS sludge impounded in lagoons; and to determine the effectiveness of the coagulent prepared from the AMDS. Recycling of the sludge in the AMD neutralization process reduced lime requirements 31% for the waste tested in the laboratory. When costs for the additional equipment needed to use this process were compared to the savings from lower lime usage, the process was cost effective. Recovery of the iron from the recycle process sludge required 25% less acid than did the sludge produced from conventional treatment. If a particular AMD treatment plant were to be built with the intention of using the waste sludge as a coagulant, this lower acid requirement would also represent a cost savings. Simply by using the sludge as a coagulant, the land requirements for AMDS storage could be reduced. When used as a coagulant the acidified AMDS performed as well as stock ferric sulfate. It was found that virtually all of the sulfate present in the coagulant exists in the wastewater effluent. However, the effluent concentrations were generally in the 200 mg/liter range, which should pose little problem. (Baker-FRC)
W83-04200

5F. Water Treatment and Quality Alteration

FACTORS AFFECTING THE CATALYTIC AND PHOTOLYTIC ENHANCEMENT OF OZONIZATION IN WATER SOLUTIONS,
Auburn Univ., AL. Dept. of Chemistry.
W. C. Neely.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-253377, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report. Auburn Univ., Ala., June 1983. 9 p, 9 Ref. OWRT A-085-ALA(1), 14-34-0001-2101.

Descriptors: *Ozone, *Oxidation process, *Phenols, Water pollution, Organic pollutants, Irradiation, Catalysts, *Wastewater treatment, Pollutant identification.

An investigation was conducted on the catalytically induced decompsotion of ozone in water solution and of the catalysis on ozonization of organic compounds in water solution using soluble metal ions. It appears that the metal ions which can serve as catalysts for ozone decomposition are those having two oxidation states, one above the oxidation potential for water and one below it, so that the catalyst can act as an electron transfer agent for the ozone water hydroxide ion system. The possible utility of catalysis in ozonization may be more limited than usually thought. Since only a restricted group of metal ions can be effective catalysts, it is not realistic to depend on their chance occurance in water; instead, they must be added as required. In addition, the ozone reaction has been shown to be complex; maximum effectiveness of use is not likely until the mechanism is better understood.
W83-03901

PHOSPHATE EXTRACTION USING FLY ASH,
South Dakota State Univ., Brookings. Dept. of Chemistry.
W. P. Jensen, and L. O. Fine.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256701, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Institute Completion Report, South Dakota State Univ., Brookings, March 1980. 8 p, 1 Fig, 4 Tab, 5 Ref. OWRT A-045-SDAK, 14-31-0001-4042.

Descriptors: *Orthophosphates, *Fly ash, *Phosphates, *Phosphorus removal, Wastewater treatment, Water treatment, Hydrogen ion concentration, Temperature, Cooling water, Iron oxides, Aluminum oxides, Minnesota, South Dakota, Organic compounds.

The Big Stone Power Plant located on the Minnesota - South Dakota border is expected to produce 400 tons of fly ash per day during its normal operation. Fly ash has been found to reduce the orthophosphate level in water solutions. No detectable orthophosphate remained in solution using concentrations above 2.5 g of fly ash per liter of solution originally containing 1 ppm phosphate at 30C, and at high temperatures the orthophosphate removal efficiency increased. Using water coming from the cooling towers of a power plant the necessary elevated temperatures could be reached with only a small additional cost. It is the insoluble part of the fly ash that is effective in removing orthophosphate from solution, and it is assumed that the active components in phosphate removal are iron and aluminum oxides. Phosphate removal efficiencies are a sensitive function of pH, with the optimum level around pH 10. It is concluded that fly ash can be used to reduce phosphate levels in surface water systems and as little as 500 ppm fly ash can be used to give near-quantitative orthophosphate removal. (Moore-SRC)
W83-03913

RAW WATER BROMIDE: LEVELS AND RELATIONSHIP TO DISTRIBUTION OF TRIHALOMETHANES IN FINISHED DRINKING WATER,
Tennessee Univ., Knoxville.
R. A. Minear, and C. M. Morrow.
Available from the National Technical Information Service, Springfield, VA 22616 as PB83-256735. Price codes: A13 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center Research Report No. 91, March 1983. 270 p, 70 fig, 46 tab, 75 ref, 4 append. OWRT A-063-Tenn(1), 14-34-0001-1145.

Descriptors: *Bromides, *Trihalomethanes, *Drinking waters, Dichlorobromomethane, Dibromochlorormethane, Bromoform, Chloroform, Ion

chromatography, Gas chromatography, Predictive modeling, Tennessee River, *Tennessee, Pollutant identification.

A study was conducted to examine the effect of raw water bromide on the formation and distribution of trihalomethanes (THMs) in finished drinking water. Twenty major water supplies in East Tennessee were selected for their significant levels of bromine-containing THMs, as demonstrated in previous studies. The cities were sampled quarterly for raw water pH, temperature, NVTOC, and bromide content, as well as finished water pH and NVTOC, and applied chlorine dose, coupled with conjunctive measurement for 7-day THMs. Few data regarding bromide levels in natural waters are currently available since most conventional colorimetric applications lack desired sensitivity, as does direct ion chromatography (IC). Although Fishman's kinetic permanganate method is adequate in the 10-100 ug/l range, it is time-consuming, and prone to certain interferences. An IC method using a sample preconcentration column has been evaluated. The method produced a 1ug/l minimum detection level using deionized water based standards, with 3 percent relative precision at 30 ug/l. Concentrator capacity varied and the highest-capacity concentrator was selected, followed by examination of raw samples regarding ranges and types of other ions present, such that the maximum concentration volume selected (50 ml) resulted in 100 percent retention of bromide. Bromide levels in the raw waters samples were found to range from 10 to 225 ug/l. Concurrent with the field sampling, laboratory chlorination experiments were made using Tennessee River Water, under controlled laboratory conditions of bromide level, chlorine dose, pH, ionic strength, temperature, and organic recursor concentration. Resultant THM formations were monitored over a 96 hour reaction period. The results concurred with observations made in previous work by such researchers as Bird and Rook. Nonlinear regression models for THM formation were generated using the laboratory chlorination data with respect to pH, temperature, chlorine dose, bromide and NVTOC level. Actual values for these variables were substituted into the regression models, using the seasonal field data. Resultant predictive THM values were then compared with actual THM values for those dates sampled. In general, these models were found to give acceptable fits, with an overall index of agreement of 74.1 for one of the models.
W83-03916

WASTEWATER TREATMENT WITH INDUSTRIAL OXYGEN (ABWASSERBEHANDLUNG MIT TECHNISCHEM SAUERSTOFF),
Linde A.G., Hollriegelskreuth (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W83-03927

PRESSURE-RELEASE FLOTATION. PRACTICAL EXPERIENCE FROM SWEDEN (ENTSPANNUNGSFLOTATION. PRAKTISCHE ERFAHRUNGEN AUS SCHWEDEN).
For primary bibliographic entry see Field 5D.
W83-03928

CURRENT STATUS OF WATER DISTRIBUTION IN FRANCE. ORGANIZATIONAL/ADMINISTRATIVE ASPECTS OF THE PROBLEM (SITUATION ACTUELLE DE LA DISTRIBUTION D'EAU EN FRANCE. ORGANISATION-ASPECTS ADMINISTRATIES DU PROBLEME).
In: Techniques et Sciences Municipales, No 3, Supp., p 7-36, March, 1981. 5 Fig, 3 Tab.

Descriptors: *Water supply, *Water distribution, *Water quality control, Water treatment, Water use, Water costs, User charges, Water demand, Water quality standards, Potable water, *France, Reviews, Water resources.

This document presents an overview of the water supply and water distribution situation in France. Discussions off the following topics are included: the water supply situation, water resources, the production and treatment of potable water, the distribution of potable water, the quality of the water distributed, water quality standards and controls, and water prices. The water system serves about 97% of the total population. Demand for water increased by 7% per year between 1969 and 1979. Potable water distribution is the responsibility of local organizations, public or private, which operate within a state-defined framework. Although the quantity of water available far exceeds current needs, the quality of many water sources is unacceptable. About 60% of the public water supplies come from underground sources. Treatment of undergound water is generally both more complex and more expensive than treatment of surface water, and also suffers from the need for small, local treatment facilities. Water distribution installations compromise pumping stations, underground or elevated reservoirs used for pressurizing, a piping system and ancillary equipment, and connections terminating in meters. Water quality regulations in France meet World Health Organization standards and are being adapted to meet directives of the European Economic Community. National regulations stipulate the types and frequencies of analyses which must be conducted. Water prices, which are fixed by local communities, vary widely throughout the country. (Carroll-FRC)
W83-03964

AIR STRIPPING OF VOLATILE ORGANICS FROM DRINKING WATER,
California Univ., Berkeley. School of Public Health.
R. E. Selleck, F. H. Pearson, V. Diyamandoglu, and D. -C. Kim.
UCB/SEEHRL Report No 82-4, Water Resources Center, University of California, Davis, April 1983. 93 p, 25 Fig, 14 Tab, 28 Ref.

Descriptors: *Organic compounds, *Solutes, *Volatility, *Chloroform, *Drinking water, Kinetics, Air-water interfaces, Bubble gages, Groundwater pollution, Ventilation, Mass transfer, Water treatment.

The initial object of this research was to evaluate the kinetics and economics of air stripping of the four trihalomethane (THM) compounds: chloroform, bromodichloromethane, dibromochloromethane, and bromoform. These substances, found in some public water supplies, are carcinogenic. When this research began, adsorption in beds of granular activated carbon was recommended; air stripping was considered economically unviable. The concentrations of the THM compounds established at equilibrium between the air and water phases (Henry's law constants) had to be known before air stripping devices could be evaluated. The emphasis in other Henry's law constant studies has generally been on those organics having volatiles equal to or greater than chloroform--the standard against which other organics are compared. Of the ten halogenated compounds studied, 1, 2 Dibromo-3-chloropropane (DBCP) had the least volatility. It is about 25 times less volatile than chloroform and 10 times more volatile than aqueous ammonia at 20C. For solutes more volatile than chloroform, relatively high stripping factors are favored, thus diminishing adverse effects of low stripping factor (gas phase) resistance to mass transfer, and of axial dispersion. Compounds with volatilities equal to or greater than chloroform can also be removed relatively easily in tray towers without forced air ventilation. An accurate and precise method of determining Henry's law constants for solutes having low volatilities remains to be devised. (Atkins-Omniplan)
W83-03991

REDUCING THE FORMATION OF TRIHALOMETHANES,
IMS Engineers, Fairport, NY.
I. M. Singh, and T. C. McTighe.
Public Works, Vol 113, No 8, p 45-49, August, 1982. 4 Fig, 1 Tab.

Descriptors: *Chlorination, *Trihalomethanes, *Water treatment, Sulfur dioxide, Chlorinated hydrocarbons, Monroe County, *New York.

In-plant studies in trihalomethane (THM) reduction were carried out at the Monroe County Water Authority, Rochester, New York, during the 1978-81. THM were reduced 62% (from an average of 33 to 21 micrograms per liter) by moving the chlorination feed point from the prechlorination mode (prior to flash mixing) to the postchlorination mode (before filtration). This change in feed point did not adversely affect the clarifier effluent water quality nor the finished water quality. Adding chlorine in the postchlorination mode saved $30,000 per year for this plant by reducing requirements for chlorine by 235,000 lbs per year and for sulfur dioxide by 22,000 lbs per year. Sulfur dioxide treatment for residual chlorine control was eliminated except for emergency situations. (Cassar-FRC)
W83-03997

DESTRUCTION OF HAZARDOUS WASTES BY ULTRAVIOLET CATALYZED OXIDATION,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 5D.
W83-04002

INVESTIGATION OF HALOGENATED ORGANICS PRODUCED IN 30 DRINKING WATER SUPPLIES IN SOME ITALIAN DISTRICTS (MODENA, REGGIO EMILIA, AND MANTOVA) (INDAGINE SULLA PRESENZA DI MODENA, REGGIO EMILIA E MANTOVA),
Modena Univ. (Italy). Ist. de Igiene.
R. Olivo, G. Aggazzotti, and G. Predieri.
Igiene Moderna, Vol 76, No 3, p 468-482, September, 1981. 6 Tab, 14 Ref.

Descriptors: *Drinking water, Water pollution, *Organic compounds, *Chloroform, Chemical analysis, *Trihalomethanes, Water supply, Chlorine, Chlorination, Water treatment, Sodium hypochlorite, *Italy.

Data are presented on the presence of some halogenated organics, mainly chloroform and related trihalomethanes, in 30 drinking water supplies of towns in three Italian districts: Modena, Reggio Emilia, and Mantova. In samples drawn from 10 water supplies, no halogenated organics were found, while in 13, some traces appeared. Samples from seven drinking water plants showed higher amounts of halogenated organics (Regio Emilia and Viadana). The total amount of halogenated organics increased after the water was chlorinated with sodium hypochlorite or chlorine gas. (Author's abstract)
W83-04023

INFLUENCE OF UV RADIATION ON THE MICROFLORA OF WATER WITH DIFFERENT DEGREES OF MINERALIZATION (EINFLUSS DER UV-STRAHLUNG AUF DIE MIKROFLORA VERSCHIEDEN MINERALISIERTER WASSER),
Vyzkumny Ustav Balneologicky, Marienbad (Czechoslovakia).
L. Svorcova.
Acta Hydrochimica et Hydrobiologica, Vol 9, No 3, p 303-316, March, 1981. 7 Fig, 5 Tab, 29 Ref. (No English Summary).

Descriptors: *Ultraviolet radiation, *Mineral water, *Disinfection, *Turbidity, *Microorganisms, Mineralization, Spring water, *Czechoslovakia, Bacteria, Enteric bacteria, Coliforms, Pseudomonas, Mesophilic bacteria, Filtration, Radiation, Water quality, *Water treatment, Water pollution treatment, Iron bacteria, Heterotrophic bacteria.

The use of ultraviolet (UV) radiation to disinfect waters from the Czechloslovak spa and spring water industries was investigated. A Stoutz actinator with separate chambers for high-voltage source and discharge tubes was employed to emit UV rays at 253 nm. Mineral waters with evaporation residues of 25-106 and 6,3000-6,500 mg/l and with 101 and 585-630 mg/l carbon dioxide, respectively, were treated. Turbidity levels were up to 50 mg/l Si02, and microorganism density was up to 50,000/ml. The water throughput of the actinator was 2-7 l/min, and the radiation dose was 1.9-8.2 kilowatt-second/sq m. Although results showed that micro-

biological pollution of the raw water varied greatly, the radiation device was able to handle bacteria levels in the millions, so that the standard level for mesophilic bacteria in drinking water of 20 per ml was never exceeded. No coliform microbes or Pseudomonas aeruginosa could be detected in treated water. In general, 99.9% of bacteria were eliminated. A lower performance level was seen in raw water with fewer bacteria. With mild turbidity (up to 15 mg/l Si02), treatment was satisfactory; above this level, water should be filtered before treatment, while water with turbidity > 50 mg/l Si02 cannot be treated in this way. UV radiation was most effective against enterobacteria; 92.8% were killed at a water throughput of 6.5 l/min and 99.9% at 2.5 l/min. Between 88.7 and 97.5% of pseudomonads were eliminated, depending on throughput level. Almost 99.9% of mesophilic bacteria were eliminated at low throughput levels; at higher levels, 86-88% were killed. Under optimal conditions, the total number of heterotrophic bacteria can be reduced five- to sixfold in water with turbidities of < 15 mg/l Si02 and threefold in water with 15-50 mg/l Si02. Iron and manganese bacteria were only slightly affected by UV radiation and quickly reestablished themselves in the water. (Gish-FRC)
W83-04046

CLARIFYING GEOTHERMAL FLUIDS,
Envirotech Corp., Salt Lake City, UT. Eimco Process Machinery Div.
D. A. Dahlstrom, R. W. Moore, Jr., and R. C. Emmett, Jr.
Chemical Engineering Progress, Vol 78, No 10, p 50-55, October, 1982. 4 Fig, 7 Tab, 6 Ref.

Descriptors: *Clarification, *Geothermal resources, *Reinjection wells, Brines, Silica, Wells, Suspended solids, Filters, Geothermal power, Water treatment, *California.

Reinjection of the brines from geothermal wells requires separation of fine suspended solids after desupersaturation of silica. A solids contact clarifier for promoting crystal growth is presented. The clarifier is tied in with a filter, and has been studied during pilot plant operations at the Geothermal Loop Experimental Facility in California near an injection well of Imperial Magma Co. To determine clarification requirements of the spent brine to 10 ppm, a small dual granular media filter was installed. The top bed was anthracite, while the lower bed was sand. This method was able to reduce silica to the saturation point without adding other chemicals. At the same time scaling has been prevented by using the internally recycled solids as seed for crystal growth. By recirculating thickened solids to the pressure flash vessels and crystallizers employed for steam generation, it also appears that scaling can be eliminated in these units. Pressure filtration can be used to produce dewatered solids which can be disposed of in an environmentally acceptable way. Spent brine clarified by granular dual-media filters can be reinjected into the formation at a reasonably constant volumetric rate per unit of pressure drop. There is also the possibility of producing inorganic by-products from the spent brine. Air-brine contact should be prevented for brine reinjection to prevent precipitation of such compounds as ferric hydroxide. Total costs per kWh of electrical production appear reasonable. (Baker-FRC)
W83-04052

CHEMICAL EVOLUTION OF ORGANIC MICROPOLLUTION DURING OZONATION OF FILTERED WATER (EVOLUTION CHIMIQUE DES MATIERES ORGANIQUES AU COURS DE L'OZONATION D'UNE EAU DE SURFACE FILTREE),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
R. Brunet, M. M. Bourbigot, B. Legube, and M. Dore.
Aqua, No 4, p 76-81, April, 1980. 5 Fig, 5 Tab, 13 Ref.

Descriptors: *Ozonation, *Water treatment, *Polarity, *Aromatic compounds, Chromatography, Spectrometry, Organic compounds, Chemical reactions, Laboratory studies, Haloforms, Trihalomethane precursors, Fate of pollutants, Halogenation, *France, Seine River.

Several analytical techniques were used to study the chemical changes occurring in organic micropollution during the ozonation of filtered water from the River Seine. Ultraviolet spectrometry and high-pressure liquid chromatography demonstrated a decrease in the aromaticity and the transformation of nonpolar compounds into substances which are more polar during ozonation. Investigation of the change in haloform precursors confirmed these observations. Ozonation of diluted aqueous solutions of pure products, including such aromatic compounds as phenols, polyhydroxybenzenes, amines, and phenoxyacetic acid derivatives, was used to further evaluate the evolution of organic micropollution. It appears that at an ozonation rate on the order of 2 milligrams per liter the degradation products of the polyhydroxy aromatic precursors are more reactive with chlorine at a neutral pH, while precursors of the methyletone type are more reactive with both iodine and chlorine at a high pH. (Carroll-FRC)
W83-04058

UTILIZATION OF WATER FROM THE OPEN-CAST MINES SITUATED NORTH OF LEIPZIG (DIE NUTZUNG DES WASSERS AUS DEN TAGEBAUEN NORDLICH LEIPZIGS),
Dresden Forschungszentrum Wassertechnik (German D.R.).
For primary bibliographic entry see Field 3C.
W83-04061

ORGANOHALOGENES AS CARCINOGENS IN DRINKING WATER (ORGANOHALOGENE ALS KARZINOGENE IM TRINKWASSER),
Institute of Hygiene, Gera (German, D.R.).
For primary bibliographic entry see Field 5C.
W83-04064

LOW ENERGY FILTRATION USING BUOYANT MEDIA,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 5D.
W83-04149

DECISION MAKING AND RISK MANAGEMENT BY INDIVIDUALS: NITRATE-NITROGEN IN THE CLIFTON SPRINGS, NEW YORK PUBLIC WATER SUPPLY,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Div. of Nutritional Sciences.
For primary bibliographic entry see Field 6F.
W83-04152

FINAL PRETREATMENT FILTERS FOR REVERSE OSMOSIS DESALINATION,
Rohm and Haas Co., Spring House, PA.
For primary bibliographic entry see Field 3A.
W83-04162

DESIGNING AND CONSTRUCTING THE TRAP FALLS WATER TREATMENT PLANT,
Bridgeport Hydraulic Co., CT. Systems Operations Dept.
M. L. Johnson, and P. W. Doe.
Journal of the American Water Works Association, Vol 75, No 3, p 124-131, March, 1983. 2 Tab.

Descriptors: *Filtration, *Dewatering, *Lamella settlers, *Water treatment(Plants), Trap Falls Plant, Bridgeport Hydraulic Company, *Connecticut, Flocculation, Sludge lagoons, Sedimentation.

The Bridgeport Hydraulic Company, Connecticut, built the 25 mgd Trap Falls Reservoir water treatment plant to improve color and turbidity to meet Safe Drinking Water Act provisions. Design and construction problems included a fast schedule, space limitations, and proximity to houses and a highway. To conserve space high filter rates and lamella settlers, which require only 1/12 the space of conventional settling basins, were used. Esthetic considerations included low profile buildings and tanks plus landscaping. Flexibility and provisions for future expansion to 75 mgd were provided. The treatment process included chemical mixing, flocculation, sedimentation, and final filtration. The plant opened in December 1980. In 1981 raw water quality was 18 color units and 1 ntu turbidity units. Treated water averaged 5 color units and 0.42 ntu turbidity. Sludge, stored in lagoons, is dewatered to the consistency of coffee grounds by natural freezing and thawing. (Cassar-FRC)
W83-04175

FORMATION OF ORGANIC CHLORINE IN PUBLIC WATER SUPPLIES,
O'Brien and Gere Engineers, Inc., White Plains, NY.
S. J. Fleischacker, and S. J. Randtke.
Journal of the American Water Works Association, Vol 75, No 3, p 132-138, March, 1983. 6 Fig, 8 Tab, 29 Ref.

Descriptors: *Chlorination, Organic compounds, *Chlorinated hydrocarbons, *Water treatment, Humic acids, Fulvic acids, Water temperature, *Organic chlorine, Disinfection.

The formation of organic chlorine compounds (OC) was studied under different conditions of chlorine dosage, pH, temperature, and ammonia concentration. Precursor material was obtained from groundwater, fulvic acids extracted from groundwater and from peat, commercial humic acid, and municipal secondary effluent. The amount of OC formed increased with increasing chlorine dosage, total organic carbon (TOC) concentration, and temperature, and with decreasing pH. A small dose of chlorine (2 mg per liter) produced more than half as much organic chlorine as a 100 mg per liter dosage. Free chlorine produced much greater amounts of both volatile and nonvolatile chlorine compounds than did combined chlorine. At chlorine doses of 2-100 mg per liter the concentrations (micrograms per liter) of volatile and non-volatile OC formed were: free chlorine, 105-193 and 317-594; combined chlorine, < 1-28 and 40-150, respectively. The proportion of chloroform to total OC increased with higher pH values. Formation of OC was 1/2 to 2/3 complete within the first two hours and essentially complete within 2 days. The level of nonvolatile OC produced over a range of precursor concentration of 0.5-5.0 mg per liter TOC in the presence of free chlorine was 143-1164 micrograms per liter (221-286 micrograms nonvolatiles per mg TOC). Conditions favoring lower OC levels are avoiding prechlorination and excessive chlorine dosages and using combined chlorine, a high pH, and cool water with a low precursor concentration. (Cassar-FRC)
W83-04188

5G. Water Quality Control

SEDIMENT POLLUTION CONTROL IN NORTH CAROLINA,
North Carolina State Univ. at Raleigh.
D. H. Howells, and H. K. Britt.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1228-1247, December, 1982. 2 Fig, 5 Tab, 4 Ref.

Descriptors: *Sediment control, *Revegetation, *Legislation, Water management, *Erosion control, Sediment erosion, Sedimentation, Silting, Highway effects, Vegetation establishment, Water law, Sanitary landfills, Water pollution control, *North Carolina.

A review of state and local sediment control programs in North Carolina in relation to urban and highway construction and sanitary landfill operations is presented. The Sedimentation Pollution Control Act was enacted in 1973 and renewed in 1981 without substantial changes. The mandatory standards of the Act state that where land-disturbing activities are near lakes or natural watercourses, a buffer zone is required to reduce siltation within 25% of the buffer zone nearest the land-disturbing activities. The Act also mandates

that the angle of graded slopes and fills can be no greater than that which can be maintained by vegetative cover or other structures, and when land-disturbing activity is undertaken on a tract of more than 1 acre, the responsible person must retain sediments within the boundaries of the tract during construction and provide a permanent ground cover sufficient to maintain erosion within 30 working days. The Act also covers aspects of technology and training, management, economics, enforcement, education, and public acceptance. State and local programs for sediment control generally enjoy public support. It is recommended that more local programs be set up, that government at all levels should set an example of sediment control practices for private industry, that greater efforts should be made toward enforcing the Sedimentation Pollution Control Act, and that more funds be allocated to meet these goals. (Geiger-FRC)
W83-03860

INTEGRATED CONTROL OF COMBINED SEWER REGULATORS,
Montreal Urban Community (Quebec).
H. N. N. Van, M. Osseyrane, and M. B. McPherson.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE6, p 1342-1360, December, 1982. 6 Fig, 6 Tab, 9 Ref.

Descriptors: *Water pollution prevention, *Wastewater treatment, Computers, *Process control, *Combined sewer outflows, *Storm sewers, Automation, Data processing, Regulated flow, Prediction, Water management, Flow rates, Pollution load, Interceptor sewers.

The feasibility of integrating all combined sewer system regulators on a given interceptor by means of a centralized automatic control scheme when no in-line or other storage system can be called upon was examined in simulation studies for 10 dynamic combined sewer regulators on a Montreal interceptor over one season. Unless flowrates can be predicted adequately in advance, no advantage over local automatic dynamic regulator control can be obtained by integrating the operation of regulators on a given interceptor. In addition, the diversion of flows by the regulators in the form of overflows must be programmed so as to minimize overflows at some time period over the duration of storm events. When a pollutant characteristic that diminishes in concentration over time is considered, it is possible to reduce emissions at designated outfalls by using integrated regulator operation when a weighting function and flowrate prediction are employed. The CUM, a special metropolitan district of Montreal, is seeking to completely automate its interceptor system. A computer based management information and control system was adopted by CUM to deal with greater amounts of information and achieve greater regulation. (Geiger-FRC)
W83-03862

USING EPA'S COMPUTERIZED DATA BASE (STORET) TO ANALYZE FOR AGRICULTURAL WATER POLLUTION,
Virginia State Water Control Board, Richmond. Bureau of Water Control Management.
For primary bibliographic entry see Field 5B.
W83-03895

MOVEMENT OF WATER AND NITRATE-NITROGEN IN A TYPICAL SILT LOAM SOIL OF WESTERN KANSAS,
Kansas Water Resources Research Inst., Manhattan.
L. R. Stone.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255497, Price codes: A03 in paper copy, A01 in microfiche. Contribution No 238, September 1982. 24 p, 11 Tab, 8 Ref. OWRT A-101-KAN(1), 14-34-0001-0118.

Descriptors: *Corn, Water use, *Water use efficiency, Profile soil water depletion, Grain yield, *Nitrate-nitrogen movement, *Kansas, Loam, Irrigation.

During a 2-year study at Tribine, Kansas, we evaluated the movement of water and nitrate-nitrogen in a deep, silt loam soil derived from loess. Treatment was irrigation amount (76, 114, or 152 mm of water per irrigation) and the test crop was corn (Zea mays L.). All plots recieved a pre-plant irrigation of approximately 150 mm in April of each year. In-season irrigation water was applied to basin plots by using gated pipe. In November 1980 and in December 1981, 180 kg of nitrogen per hectare were applied to the plot area. Nitrate-nitrogen concentration in the soil profile was not significantly influenced by irrigation amount. Water use efficiency was significantly greater with the 114 and 152 mm irrigation amounts than with the 76 mm amount. The 76 mm irrigations did not wet the soil to the 60 cm depth in 1981. For our study conditions, the larger irrigation amounts (114 and 152 mm) did not cause leaching of nitrate-nitrogen from the corn root zone. Undoubtedly, excessive amounts of nitrogen fertilizers and excessive amounts of irrigation water could produce nitrate-nitrogen leaching from these soils. But recommended rates of nitrogen fertilizers and judicious use of irrigation water will not cause extensive in-season leaching of nitrate-nitrogen in the deep, silt loam soils of western Kansas.
W83-03908

COPPER SUSCEPTIBILITY OF THREE GROWTH STAGES OF THE GREEN ALGA HAEMATOCOCCUS,
Iowa State Univ., Ames. Dept. of Botany.
N. L. Pearlmutter, and M. A. Buchheim.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256768, Price codes: A05 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute Completion Report No 129, July 1983. 76 p, 38 Fig, 8 Tab, 90 Ref. OWRT A-081-1A(1), 14-34-0001-2117.

Descriptors: *Copper sulfate, *Haematococcus, *Algal growth stages, Algal blooms, *Chlorophyta, *Eutrophication, Water pollution effects.

Three growth stages of the green alga, Haematococcus, were examined to determine their survival and recovery following a 12-hour exposure to copper. Copper uptake of flagellate cells, palmelloid cells, and akinetes was measured by atomic absorption spectrophotometry, and cell counts were used to determine the numbers of surviving cells as well as growth rates following exposure to copper. The location of amassed copper was determined with cytochemical methods developed for light microscopy and transmission electron microscopy. Flagellate cells accumulated less copper per cell than palmelloid cells or akinetes. When compared to the other growth stages on a volume basis, however, flagellate cells were found to have accumulated significantly more copper. This may account for the greater sensitivity of flagellate cells to low concentrations of copper. High metabolic activity of flagellate cells to low concentrations of copper. High metabolic activity and a large surface-to-volume ratio are also implicated as major factors contributing to decreased survival and slow recovery of flagellate cells from copper poisoning. Akinetes were least affected by exposure to copper although germination of palmelloid-producing akinetes was inhibited. A copper-enriched but incomplete growth medium was used for incubation of the cells during treatments. The survival and growth of cells incubated in this medium and a complete growth medium was compared and the differences found to be negligible. Copper accumulated in the cell walls and external cell mucilage of inhibited akinetes and palmelloid cells. With the exceptiion of a few cytoplasmic sites, deposition of copper was complete throughout dead cells of any growth stage. Starch bodies, vacuoles, and occasionally pyrenoids did not accumulate detectable amounts of copper. Cellular sites external to the plasma membrane appear to act as nontoxic areas that may sequester copper ions and prevent them from reaching more sensitive cytoplasmic sites.
W83-03919

DYNAMIC ESTIMATES OF RIVER POLLUTION UNDER CONDITIONS OF REGULATION OF THE RIVER AND ANTHROPOGENIC RUNOFF,
For primary bibliographic entry see Field 5B.
W83-03937

MECHANICAL CLEANING EQUIPMENT FOR STORMWATER BASINS (MASCHINELLE RAUMEINRICHTUNGEN FUR REGENBECKEN),
Rheiner Machinenfabrik Windhoff A.G. (Germany, F.R.).
For primary bibliographic entry see Field 8C.
W83-03942

LEGAL LIMITS FOR 'EXCESSIVE' THRESHHOLD LEVELS FOR COMPANIES INDIRECTLY DISCHARGING WASTEWATER (RECHTLICHE GRENZEN FUR GRENZWERTE BEI INDIREKTEINLEITERN),
For primary bibliographic entry see Field 6E.
W83-03943

PRINCIPALS OF ECOLOGICAL AND HYGIENIC REGULATION OF WATER QUALITY,
For primary bibliographic entry see Field 6E.
W83-03950

AGRICULTURE AND WATER QUALITY IN THE CANADIAN GREAT LAKES BASIN: IV. NITROGEN,
Department of Agriculture, Summerland (British Columbia). Research Station.
For primary bibliographic entry see Field 5B.
W83-03988

ENHANCEMENT OF WATER QUALITY IN NEBRASKA FARM PONDS BY CONTROL OF EUTROPHICATION THROUGH BIOMANIPULATION,
Nebraska Univ., Lincoln.
G. L. Hergenrader.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265033, Price codes: A03 in paper copy, A01 in microfiche. Nebraska Water Resources Center Completion Report, September 1983. 30 p, 9 Tab, 5 Ref. OWRT A-067-NEB(1), 14-34-0001-2129.

Descriptors: *Water quality control, Zooplankton, Phytoplankton, Biomass, Water purification, Predation, *Nebraska, Eutroplication, *Biomanipulation, Piscivore, Planktivore, *Farm ponds.

This research was a pilot project to demonstrate the feasibility of improving water quality in surface waters by enhancing natural zooplankton grazing on phytoplankton through manipulation of the fish communities. Young-of-year planktivorous crappie and piscivorous northern pike were introduced into two eutrophic farm ponds in the Lower Platte South Natural Resources District to evaluate the effects of controlled planktivore predation on zooplankton and phytoplankton communities. For each experimental treatment (i.e., presence of planktivore alone; presence of piscivore with planktivore) one pond was used as a natural 'control' to compare against the pond receiving the experimental treatment. In the ponds containing planktivorous young-of-the-year crappie, the zooplankton community underwent a shift in size and composition towards a smaller species assemblage, less efficient as grazers. Phytoplankton biomass increased dramatically during this period with a resultant decrease in water clarity. In the experimental pond receiving piscivorous pike, the planktivore population was greatly reduced in numbers. As a result, the zooplankton community shifted back towards an assemblage of moderate to large sized species more efficient as grazers. However, phytoplankton biomass remained fairly constant during the growing season at levels approximately 30% lower than the previous years maximum. The overall trends observed over the 2-year study period supported the hypotheses that piscivore predation upon planktivores could release zooplankton grazers from size selective predation pressure and in turn graze down the phytoplankton biomass to lower levels.
W83-03995

CLOSTRIDIUM PERFRINGENS AS AN INDICATOR OF STREAM WATER QUALITY,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 5A.
W83-03999

ENVIRONMENTAL CORRECTIVE PROGRAMS AT THE LA GRANDE COMPLEX (LES AMENAGEMENTS CORRECTIFS D'ENVIRONNEMENT AU COMPLEXE LA GRANDE),
Societe d'Energie de la Baie James, Montreal (Quebec).
For primary bibliographic entry see Field 6G.
W83-04060

GROUNDWATER POLLUTION: A THREAT TO PUBLIC WATER SUPPLY. (GRUNDWASSERVERUNREINIGUNGEN - BEDROHUNG FUR DIE OFFENTLICHE WASSERVERSORGUNG.),
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
H. Sontheimer, P. Cornel, J. Fettig, and U. Rohmann.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 11, p 521-530, 1982. 9 Fig, 5 Tab, 30 Ref.

Descriptors: *Groundwater pollution, *Water treatment, Drinking water, Groundwater management, Water quality, Hydrocarbons, Nitrates, Physicochemical treatment, Biological treatment.

Halogenated hydrocarbons and nitrate have been increasingly found as groundwater pollutants in the past few years. Frequently the source of the contaminants is well known. However, if the water is to be restored to a quality suitable for drinking, specific treatment measures must be undertaken. Physicochemical methods such as stripping and adsorption can be used for the removal of halogenated hydrocarbons. Until recently these procedures had not been much used for the treatment of groundwater; they are well known methods, but are not necessarily inexpensive. Biological processes seem to have the edge for removal of nitrate contaminants, especially if part of this treatment will be done using underground passage, as this method has proven worthwhile in the treatment to remove oil polluted waters in the Karlsruhe waterworks. (Baker-FRC)
W83-04090

EPA'S NEW LAND DISPOSAL RULES-A CLOSER LOOK,
For primary bibliographic entry see Field 5E.
W83-04100

THE REGIONAL SEAS PROGRAM: WHAT FATE FOR UNEP'S CROWN JEWELS.,
For primary bibliographic entry see Field 5B.
W83-04131

ROLE OF CONSERVATION EASEMENTS IN INLAND LAKE MANAGEMENT,
Wisconsin Univ.-Madison. Water Resources Center.
For primary bibliographic entry see Field 6E.
W83-04153

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

ECONOMIC OPTIMIZATION OF IRRIGATION,
Oregon State Univ., Corvallis.
For primary bibliographic entry see Field 3F.
W83-04007

OPTIMUM CAPACITY OF A RUN-OF-RIVER PLANT,
International Engineering Co., Inc., San Francisco, CA.
For primary bibliographic entry see Field 8C.
W83-04167

6B. Evaluation Process

LANDOWNERS, RECREATIONISTS, AND GOVERNMENT: COOPERATION AND CONFLICT IN RED RIVER GORGE,
Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 7A.
W83-03903

REUSE VERSUS RETURN FLOWS: CONSIDERATIONS FOR SELECTING A WATER SUPPLY STRATEGY,
Nevada Univ. System, Reno. Desert Research Inst.
M. D. Mifflin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265082, Price codes: A02 in paper copy, A01 in microfiche. Publication 883, August 1983. 13 p, 5 Fig, 1 Tab, 5 Ref. OWRT A-079-NEV(1), 14-34-0001-7059.

Descriptors: *Water management, *Water reuse, Water requirements, Water supply development, *Return flow, *Nevada, Las Vegas.

This study addresses potential water management strategy to serve the Las Vegas area from the present time on into the 21st century. The U.S. Supreme Court Decree in Arizona vs. California defined Colorado River allotments to the Decree States in terms of annual consumptive use. In other words, water diverted from the River that is not consumptively used is allowed to flow back to the Colorado River for return flow credit. The net diversion is considered to be the legal limit but gross yearly diversions can considerably exceed this value if return flow credits are high. Water reuse becomes viable if costs associated with return flow credit water become high. Then the economic advantage of allowing wastewater to return to the Colorado River become lost. Return flow water quality requirements and associated treatment costs for wastewater flowing in the Wash, as well as the incremental and treatment costs for using the additional Lake Mead water in an amount equal to the return flow credit are the major costs associated with the return flow management option. However, as long as the cost of using Lake Mead water is lower than the costs associated with reusing the wastewater, the management strategy developed in the 1960's remains viable. Over the next 50 years, the reuse strategy could be adopted in lieu of the return flow credit strategy since sufficient water is available to meet all anticipated needs. The potable water available from the Colorado River without return flow credit to Las Vegas Valley is 280,000 acre-feet/yr which exceeds the projected year 2030 potable requirement of 220,000 acre-feet. Use of that quantity of potable water should generate approximately 120,000 acre-feet of wastewater which could be reclaimed and reused. Thus, the combined available Colorado River water, reclaimed and reused wastewater plus groundwater exceed the year 2030 total water demand.
W83-04001

QUICK RETURNS DON'T PAY IN WATER AND SOIL CONSERVATION,
A. Bell.
Soil and Water, Vol 16, No 5-6, October, 1980. 2 Tab.

Descriptors: Planning, Water resources development, *Economic aspects, Irrigation projects, Water supply, Water demand, *New Zealand, Regulations, *Costs.

On 18 December 1979, the New Zealand Cabinet Committee on Expenditure directed that all new water and soil schemes commencing after March 1980 would have to show an internal rate of return of at least 15%. Before this directive the internal rate of return (IRR) had been only one of eight criteria applied for funding water and soil works. Other criteria included the need to protect assets and the spread of works by types and regions. Demanding an exclusive and immediate economic criterion for schemes would eliminate most erosion and flood control works, many rural water supply schemes, and pastoral irrigation schemes. Only irrigation for horticulture was relatively certain to get funding. Virtually no works would go ahead in the South Island. The solution to the resulting confusion was to form a committee, and on 9 April a joint Cabinet/Caucus committee was established. On August 4, 1980, the Committee on Expenditure approved a final review of criteria and subsidy rates which should remain valid for the foreseeable future. The new policy restores order to water and soil funding from 1 October 1980. (Baker-FRC)
W83-04024

P.I.D. REGULATION REVISITED,
Lavalin, Inc., Montreal (Quebec).
G. D. Ransford.
International Water Power and Dam Construction, Vol 35, No 1, p 31-34, January, 1983. 2 Fig, 3 Tab, 5 Ref.

Descriptors: *Safety, *Hydroelectric plants, *Resources management, *Economic aspects, *Dam stability, Dams, Frequency analysis, Mathematical studies, Surge tanks, Electrical equipment, Evaluation.

A previous analysis compared two-element (proportional-integral) governors and three-element (proportional-integral-differential) governors for the safety regulation of hydroplants and concluded that a three-element governor eliminated the need for surge tanks, discharge regulators, larger pipelines or higher values of the generator flywheel effect. The implications of added derivative control were examined further using optimization on an objective basis. Considerations of frequency control, waterhammer transients, and rotor acceleration were also taken into account. Results showed that the slightly more precise three-element governor's control over frequency variations seems to be offset by a sharp deterioration in waterhammer. Conventional servomechanism analysis using transfer functions is invalid when using a proportional-integral-differential governor. It was concluded that there is no reason to prefer a three-element governor over a two-element governor or accelerotachometric type. (Geiger-FRC)
W83-04080

AN ECONOMIC EVALUATION OF BENEFITS AND COSTS OF MAINTAINING INSTREAM FLOWS,
Utah Water Research Lab., Logan.
R. Narayanan, D. T. Larson, A. B. Bishop, and P. Amirfathi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105543, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Planning Series UWRL/P-83/04, Utah Water Research Lab., June 1983. 48 p, 9 Fig, 35 Tab, 34 Ref. OWRT A-052-UTAH(1), 14-34-0001-1147.

Descriptors: *Instream flow, Recreation, *Benefits, *Cost-benefit analysis, Opportunity costs, Recreation, Irrigation, Water rights, Water law, Appropriation, Market value, Resource allocation, Fishing, Low flow, *Utah, Little Bear River.

Instream flows enhance recreation, hydropower, fish and wildlife maintenance, and riverine ecosystems. Each use has water requirements that vary over time in unique patterns. The largest determines the overall instream requirement at any given time and must be considered in competition with the demand for municipal and agricultural uses. Two obstacles to integrating instream uses into the appropriation system of water law are difficulty in satisfying the legal requirements of an appropriation for a public use and the fact that instream flow uses are more environmental than economic in character. The extreme options for allocating flow between these user groups are to give them the most junior rights under appropriative water law and provide instream flows to a desired average, and to give instream flows top priority. Neither extreme is reasonable; the first

sometimes allocates no water at all for instream flow in dry years and the second inflicts unnecessarily large benefits foregone on agriculture. A compromise is to reserve some instream flow with senior rights. A stochastic linear programming model was used to estimate the expected benefits foregone to agriculture users. The models provided a framework for maximizing benefits and were applied to various flow levels. A case study application to the Blacksmith Fork of the Little Bear River was based on the instream values being predominantly recreational with benefit estimates based on user surveys and travel costs. Agricultural losses increased as more senior rights were taken, but the method for providing instream flows made less difference for larger targeted flows. The results provide a basis for optimizing instream flow levels, but further methodological development is needed.
W83-04156

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

THE PROBLEMS AND BENEFITS OF SMALL-SCALE HYDRO (PART 2).
International Water Power and Dam Construction, Vol 35, No 3, p 49-54, 1983. 3 Fig, 2 Tab.

Descriptors: *Automation, *Economic aspects, *Conferences, *Hydroelectric plants, *Developing countries, *Cost-benefit analysis, Project planning, Evaluation, Construction costs, Operating costs, Rural areas.

The advantages and techniques of remote and automatic operation of hydro units were the major themes of Session II of the First European Conference on small hydro systems. Papers were presented on programmable control, equipment choice, hard-wired systems, and the differing requirements of isolated and integrated small-scale hydro stations in Italy, Germany, and France. The third session of the conference examined financial, economic and administrative aspects of small hydro schemes. Papers given at this session discussed the activities of the UNIDO organization in the field of small hydro, small recuperation plants, small scale hydro schemes for developing countries, and cost feasibility for the construction of a new hydro unit. Other speakers discussed the factors affecting the development of micro hydro schemes in Switzerland, the administration of hydro streams in France, the application of small hydro for rural electrification in developing countries, and the development of small hydro in Italy. The potential markets for small hydro in the United States were also examined. (Geiger-FRC)
W83-04170

6D. Water Demand

DROUGHT MANAGEMENT CONCEPTS: LESSONS OF THE 1976-77 U. S. DROUGHT,
R. Narayanan, T. C. Hughes, M. McKee, H. Fakhraei, and H. H. Fullerton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-257527, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Planning Series UWRL/P-83/02, June 1983. 87 p, 13 Fig, 23 Tab, 78 Ref, 1 Append. OWRT B-024-UTAH(1), 14-34-0001-1271.

Descriptors: *Water demand, Water supply, Municipal water, *Drought, Pricing regulations, *Water conservation, Water use, User charges, *Utah, Model studies.

The 1976-77 drought inspired a variety of efforts to ration the limited water supply. The three most common in Utah were found from a survey of 33 municipal water supply systems to be 1) restrictions on times when outside use is permitted, 2) price increases, and 3) upper limits to allowable monthly water use. A regression model applied to use data for these communities showed that mandatory water use regulations proved much more effective than price increases in reducing water use. A theoretical analysis of the demand and supply functions showed the current pricing schedule to be about optimal. A third model showed that there were substantial economic losses, largely in the form of reduced consumer surplus for residential users, associated with the 1977 regulations. The third model analyzed various management policies in terms of their impact on net benefits to the agricultural and municipal sectors. The model revises water allocations monthly, to match a changing hydrologic situation. It can very constraints in a manner that simulates an institutional environment ranging from total freedom of price changes and water exchanges between sectors to those constraints existing during the 76-77 drought.
W83-03922

REUSE VERSUS RETURN FLOWS: CONSIDERATIONS FOR SELECTING A WATER SUPPLY STRATEGY,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 6B.
W83-04001

6E. Water Law and Institutions

FEDERAL TAX LAWS AND SOIL AND WATER CONSERVATION,
California Univ., Davis. Dept. of Agricultural Economics.
R. A. Collins.
Journal of Soil and Water Conservation, Vol 37, No 6, p 319-322, November/December, 1982. 1 Ref.

Descriptors: *Taxes, *Farming, Conservation, Tax rates, *Soil conservation, *Water conservation, Legal aspects, Agriculture, *Tax laws.

Federal tax laws relating to soil and water conservation have become increasingly complex since 1954. The 1954 Internal Revenue Code permits deduction (limited to 25% of gross farm income) of soil conservation expenditures to reduce ordinary taxable income rather than capital gains income. For an average farmer this provision reduces the farmer's cost of a conservation project by about 17% for small projects and by a smaller percentage for larger projects. The 25% deduction limit is more beneficial to farmers in the lower tax brackets. It may be carried backward or forward, avoiding tax losses associated with net operating losses. The 1969 Reform Act eliminated some of the tax shelters used by high income professionals, qualified as farmers by law, but more interested in land development for profit. This law required investors to retain land for 10 years to take advantage of the capital gains provision. The 1978 Revenue Act and its interpretations are complex and easily misunderstood. The Act concerns taxation of the government's contribution to conservation projects. Farmers who do not plan to sell their land in the next 20 years can realize a tax advantage. (Cassar-FRC)
W83-03857

SEDIMENT POLLUTION CONTROL IN NORTH CAROLINA,
North Carolina State Univ. at Raleigh.
For primary bibliographic entry see Field 5G.
W83-03860

INSTITUTIONAL FRAMEWORK FOR RURAL WATER SUPPLY: A COMPARATIVE ANALYSIS OF NORTH CAROLINE, SOUTH CAROLINA, AND VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. E. Cox, and K. S. Patrizi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255430, Price codes: A09 in paper copy, A01 in microfiche. Virginia Water Resources Center Completion Report, Blacksburg, January 1983. 186 p, 19 Tab, 5 Append, 352 Footnotes. OWRT B-095-VA(1).

Descriptors: *Institutional constraints, *Water supply, Administrative regulation, Drinking water, *Rural areas, Water supply development, Water quality, Planning, Governmental interrelations, Financing, *Virginia, *North Carolina, *South Carolina.

Americans living in rural areas and small communitites experience a disproportionate share of water supply problems--both of quantity and quality. Their systems confront special economic and financial problems because of the higher costs of system development in areas of low population density and the generally lower incomes of residents. This study sought to determine whether existing institutions adequately recognize and address the unique problems experienced by water supply systems in rural areas--specifically, in North Carolina, South Carolina, and Virginia. The report first describes a variety of institutional arrangements for provision of water supply and their strengths and weaknesses. Second, it analyzes programs for technical and financial assistance from federal and state governments and includes a comparative evaluation of the programs of the three states. Third, it analyzes federal and state regulatory mechanisms applicable to water supply operations, with special emphasis on the impact of such regulation on small systems. The analysis of the laws and administrative programs of three states is extended by case studies to illustrate actual operational experiences of rural suppliers within these states.
W83-03902

LEGAL LIMITS FOR 'EXCESSIVE' THRESHHOLD LEVELS FOR COMPANIES INDIRECTLY DISCHARGING WASTEWATER (RECHTLICHE GRENZEN FUR GRENZWERTE BEI INDIREKTEINLEITERN),
H. Keune.
Wasser, Luft and Betrieb, Vol 25, No 7/8, p 16-17, July/August, 1981. 24 Ref. (No English Summary).

Descriptors: *Water law, *Heavy metals, *Water quality standards, *Financing, *Wastewater management, Wastewater treatment, Municipal wastewater, Industrial wastewater, Wastewater disposal, Sludge disposal, Legal aspects, Agriculture, *Federal Republic of Germany, Costs, Economic aspects.

The designing of a West German ordinance concerning the application of treated sludge of agricultural land has led to threshold levels for heavy metals and other substances in wastewater being proposed by municipal wastewater authorities that are impossible to adhere to. It is considered likely that state authorities will follow this trend. The argument for setting such high standards is that ecology is more important than economy; in this case, it is the public economy that is being set against the private (i.e., businesses that are expected to conform to the standards at their own cost), and the result will be loss of jobs or even the closing of businesses. This trend can only be altered by a disclaimer being written into the law for moderately sized companies who discharge heavy metals or by the municipalities' assumption of the financial responsibility for wastewater treatment. If the trend is not reversed, the danger exists that environmental protection will strangle itself by being financially unrealizable. In civil law, regulations that lead to preventing a business from operating or to prevention or impedance of its economic growth are disallowed; this could also apply to the banning of equipment that is not environmentally compatible. A well-know principle of law states that nonsensical regulations or those that legislate something realistically impossible are invalid. There is also the concept of the 'excess ban' that calls into question administrative acts that require actions considered excessive. The applicability of these principles should be investigated. The principle of industry-wide standards may also be applied: existing regulations applicable to an entire industry can only be changed with good reason, and proposals by individual municipalities are not reason enough. State law has already placed the responsibility for wastewater treatment on the municipalities, though they also have the authority to order preliminary treatment by private industry (while confirming to the above principles). (Gish-FRC)
W83-03943

PRINCIPALS OF ECOLOGICAL AND HYGIENIC REGULATION OF WATER QUALITY,
G. N. Krasovskii, L. I. El'piner, A. M. Beim, and I. V. Sutovskaya.
Water Resources (English Translation), Vol 9, No 2, p 111-112, March-April, 1982. 2 Tab, 59 Ref. Translated from Vodnye Resursy, No 2, p 3-19, March-April, 1982.

Descriptors: *Water quality, *Regulations, Water conservation, Fisheries, Public health, Water quality control.

The extremely complex problems of the conservation of nature have a number of important aspects occuring in connection with the provision of safe water use and protection of waters from pollution. Currently the approach to this problem is associated with the need to solve problems of preserving freshwater bodies as components not only of the hydrosphere but also of the biosphere of the entire planet. Analysis of current scientific literature indicates a need to change from the solution of problems of individual water users to an examination of problems of mankind as a whole when it is a matter of quality of water resources. Development of the maximum allowable concentrations of pollutants was based on current hygienic standardization of harmful substances. Hygienic standards regulate the content of pollutants only in those water bodies which are used for domestic water supply and amenities, including recreational water use, and not over the entire length of the water body or at places of the outfall of wastewaters but only at the first points of public water use from the source of pollution. The occurrence of new pollution sources and the expansion of their geography led to the occurrence of a number of new and important aspects in the problem of protecting water bodies. The differences in purposes of water use and in the water quality requirements of different water consumers gives rise to the simultaneous coexistence of hygienic and fishery standards for the same chemical water pollutants. Technical and economic approaches to water quality regulation are considered along with approaches to ecological standardization and principles of unified ecological and hygienic standardization. (Baker-FRC)
W83-03950

GROUNDWATER PROTECTION - SUFFICIENT AGAINST THREATS TO PUBLIC WATER SUPPLY DUE TO GROUNDWATER POLLUTION. (GRUNDWASSER-SCHUTZ - AUSTREICHEND ANGESICHTS DER BEDROHUNG DER OFFENTLICHEN WASSERVERSORGUNG DURCH GRUNDWASSERVERUNREINIGUNGEN.),
Bonn Univ. (Germany, F.R.). Inst. fuer das Recht der Wasserwirtschaft.
For primary bibliographic entry see Field 5B.
W83-04093

ROLE OF CONSERVATION EASEMENTS IN INLAND LAKE MANAGEMENT,
Wisconsin Univ.-Madison. Water Resources Center.
W. P. O'Connor, and G. Chesters.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105519, Price codes: A02 in paper copy, A01 in microfiche. Publication No WIS WRC 83-03, 1983. 24 p, 1 Tab, 26 Ref. OWRT A-096-WIS(1), 14-34-0001-0153.

Descriptors: *Conservation, *Easements, *Inland waterways, *Lakes, *Taxes, Economic aspects, Legal aspects, Preservation, Water quality, Lake management.

The discussion is designed to provide lake management organizations with information on the nature of conservation easements and some of the legal, institutional and tax (income, estate, and property) considerations involved in developing conservation easement programs. Certain aspects of conservation easements are discussed using representative jurisdictions as examples; however, the survey is not intended to be exhaustive. Instead, it serves as an introduction to a complex subject area, providing the reader with an understanding of the issues involved and the kinds of lake management objectives that conservation easements may help attain. Most states have enacted statutes--including the recently adopted Uniform Conservation Easement Act--recognizing conservation easements and ensuring their long-term enforceability. The donation of these partial interests in real property by conservation organizations is encouraged by specific provisions of the Internal Revenue Code permitting landowners to deduct from taxable income the value of qualifying easements granted to public or certain private organizations. Additional tax incentives for donation are available to land-owners under federal estate tax law and the death, inheritance, income, and real property tax laws of many states. This device offers potential in lake management for the enhancement and protection of water quality and for preservation of undeveloped or scenic areas, thereby benefitting the recreational and aesthetic aspects of the lake and its watershed.
W83-04153

AN ECONOMIC EVALUATION OF BENEFITS AND COSTS OF MAINTAINING INSTREAM FLOWS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 6B.
W83-04156

6F. Nonstructural Alternatives

A COMPLEX SYSTEM FOR THE STADARDIZATION OF WATER POLLUTANTS -- DISCUSSION OF PROPOSALS MADE BY KRASSOVSKIY ET AL (KOMPLEXES SCHEMA ZUR NORMIERUNG VON WASSER SCHADSTOFFEN -- EINE BETRACHTUNG ZU VORSCHLAGEN VON KRASSOVSKIJ ET AL),
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
H. -J. Dobberkau, H. Horing, and K. Strobel.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 5, p 401-406, May, 1980. 1 Tab, 4 Ref. (No English Summary).

Descriptors: *Water pollution sources, *Standards, *Classification, *Public health, *Water quality control, Water pollution control, Water quality standards, Systematics, Toxicity, Toxins, Self-purification, Organoleptic properties, Hazardous materials, Pollutants.

The rapidly increasing development, application, and distribution of synthetic chemical compounds has necessitated the establishment of standards for potential environmental pollutants. A complex system for the testing and setting of standards for harmful substances in water proposed by Krassovsky et al. in 1978 is described and discussed. The basis of the program is determination of the MAC for each substance, i.e., the maximal allowable concentration in water that has no direct or indirect influence on the health status of present and future generations. The establishment of standards rests on testing of the substance in question according to three characteristics of harm: influence on the hygienic regime of the water (self-purification capacity), influence on organoleptic properties, and influence on the health status of the population. For the first two characteristics, standardized experiments are conducted, including double-blind-type studies for odor and taste. Animal experiments are performed for the third characteristic. Additional principles of the system are that a complex investigation to establish each substance's limiting characteristic of harm must be made, that a threshold of influence can be determined for each characteristic of harm, that the maximum no-effect concentration (MNC) can be found, and that the MAC must be retested periodically. Hazard category is established by a stepwise procedure, in which toxicological studies are stopped once the hazard fulfills the requirements for a certain class -- in this way the length of study is kept short. (Gish-FRC)
W83-04065

DECISION MAKING AND RISK MANAGEMENT BY INDIVIDUALS: NITRATE-NITROGEN IN THE CLIFTON SPRINGS, NEW YORK PUBLIC WATER SUPPLY,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Div. of Nutritional Sciences.
C. A. Bisogni, and A. T. Lemley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105501, Price codes: A02 in paper copy, A01 in microfiche. Center for Environmental Research Completion Report, October 1983. 8 p, 2 Ref. OWRT A-098-NY(1), 14-34-0001-2134.

Descriptors: Water supply, *Nitrate, *Public participation, Notification, Customer concerns, Social aspects, *New York, Clifton Springs, *Nitrogen, *Attitudes, Domestic water, *Risks, *Decision making, Surveys.

The public water supply in Clifton Springs, New York has nitrate levels greater than the maximum contaminant level of 10 mg N/liter. The customers have been notified since 1978 by mail, and a Citizens' Advisory Committee was established in 1981 in order to secure public cooperation in solving the problem. A survey project which included a mail questionnaire and indepth interviews in 10% of the village households was instituted to determine the effectiveness of both notification and resident involvement in influencing the public knowledge of their water problem, their concerns about water quality, and their willingness to pay to correct the problem. Respondents had a good understanding of the specific water problem and a positive attitude toward the newsletter published by the Citizens' Advisory Committee. The results indicate that public participation in decision making is an effective method of educating the community and of securing its cooperation. Recommendations for public education programs on water contamination problems are made.
W83-04152

6G. Ecologic Impact Of Water Development

DEFINING STREAM FISH MICROHABITAT REQUIREMENTS FOR WATER PROJECT PLANNING,
Utah State Univ., Logan. Coll. of Natural Resources.
W. T. Helm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256727, Price codes: A02 in paper copy, A01 in microfiche. Utah Center for Resources Research Completion Report, Utah State University, Logan, November 1982. 13 p, 1 Fig, 3 Tab, 21 Ref. OWRT B-177-UTAH(1), 14-34-0001-9140.

Descriptors: Brown trout, *Fish management, *Aquatic habitats, Light penetration, *Environmental impact, Stream fisheries, *Utah, Logan River, *Project planning.

Environmental concerns are generating criteria for protecting stream fish habitat from flow regime changes caused by water resources development and use, but the lack of scientific basis for many of the promulgated water requirements creates grave doubts that true protection will be achieved. Economically productive water use is being prevented without assurance of environmental gain. The need for scientific habitat need characterization was addressed through the systematic collection of data on brown trout preferences in the Blacksmith Fork of the Logan River, Utah. Brown trout daily activities were divided between resting and feeding, and the fish population was divided among age groups observed to have different times and locations for these activities. Microhabitat components (velocity, depth, and light) were defined, measured, and mapped for a 90-meter river section. A scuba diver searched the area identifying located brown trout by age group and activity. Comparisons of habitat character with fish locations set a range of acceptable numerical values for each component. For example, adult trout require velocities less than 24 cm/sec for resting and less than 45 cm/sec while feeding. These quantified component ranges can be used for formulating habitat protection ranges that

will effectively protect fish while permitting economical but harmless water development.
W83-03915

THE NON-FISHERIES BIOLOGICAL RESOURCES OF THE HANFORD REACH OF THE COLUMBIA RIVER,
Battelle Pacific Northwest Labs., Richland, WA.
W. H. Rickard, W. C. Hanson, and R. E. Fitzner.
Northwest Science, Vol 56, No 1, p 62-76, 1982. 5 Fig, 2 Tab, 34 Ref.

Descriptors: *Wildlife, *Environmental effects, *Recreation, Reservoir operation, Nuclear powerplants, Powerplants, Hanford, *Columbia River, *Washington, Radioisotopes.

The non-fisheries biological resources of the 90 km long Hanford Reach of the Columbia River are documented. This free-flowing and undammed section of the river has been a wildlife refuge for 35 years. Streamside vegetation, consisting of a narrow zone of shrub-willows, rushes, grasses, and forbs, has responded to the dramatic changes in water levels produced by reservoir operation upstream. However, no baseline reference points are available for comparison. Bald eagles, attracted to salmon carcasses, have increased during the past 20 years from 6 to 20. Many species of geese, ducks, fish-eating birds, upland game birds, and shore birds have been listed. Numbers of geese and ducks have been decreased by predation and by disturbance from boating and hunting. Mule deer are numerous, but the population is not robust. Coyotes are numerous, preying on nesting geese and mule deer fawns. A variety of furbearing mammals and small mammals have also been observed. Several researchers have investigated the levels of radionuclides and persistent chemicals in animal bodies and droppings. (Cassar-FRC)
W83-04017

ENVIRONMENTAL CORRECTIVE PROGRAMS AT THE LA GRANDE COMPLEX (LES AMENAGEMENTS CORRECTIFS D'ENVIRONNEMENT AU COMPLEXE LA GRANDE),
Societe d'Energie de la Baie James, Montreal (Quebec).
D. Therrien.
Canadian Water Resources Journal, Vol 7, No 2, p 147-162, 1982. 6 Fig, 22 Ref.

Descriptors: *Environmental effects, *Reservoirs, Water resources development, Environmental protection, Natural resources, Bays, Dams, Canada, *James Bay Territory, Aesthetics, Recreation.

Increased concern about the quality of the environment has made it necessary for developers of natural resources to provide for protection of the environment and to respect the desires of the people affected. In developing the La Grande Complex, which comprises a series of dams, reservoirs, and canals to the east of James Bay in Canada, the Societe d'energie de la Baie James has had to fing original solutions to protect the integrity of the James Bay territory, avoid disruption of the traditional way of life practiced by the Amerindian populations in the area, and at the same time achieve the desired water resources management and hydroelectric power development goals. The first reservoir in La Grande Complex, LG 2, served as a trial area for the project. A variety of approaches were used to provide for protection of the biological quality of the environment and to allow use of the water bodies for both traditional and recreational activities. Other measures were designed to create a visually attractive environment near those sites likely to be visited. These corrective programs have been in operation at the LG 2 site since 1977. Although they are still being evaluated, information to date indicates that they have had a beneficial effect on the ecology of the area, minimizing the environmental harm caused by the project. Lessons learned at this site can be used to improve the development of future hydroelectric projects. (Carroll-FRC)
W83-04060

POLYCYCLIC AROMATIC HYDROCARBONS-ARE THEY A PROBLEM IN PROCESSED OIL SHALES,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 5B.
W83-04148

PARASITE COMMUNITIES AS INDICATOR SYSTEMS FOR PREDICTING THE EFFECTS OF SURFACE WATER MANAGEMENT OPTIONS ON THE BIOTA OF PRAIRIE RIVERS,
Nebraska Univ.-Lincoln. School of Life Sciences.
J. Janovy, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105535, Price codes: A02 in paper copy, A01 in microfiche. Nebraska Water Resources Center Completion Report, September 1983. 15 p, 6 Fig. OWRT A-068-NEB(1), 14-34-0001-2129.

Descriptors: Ecology, *Ecological distribution, *Fish parasites, *Trematodes, Aquatic life, Microorganisms, Water management, Fish management, *Bioindicators, *Nebraska, Platte River, Plains killifish, Fundulus Kansae, Larval digenetic trematodes.

This study of the parasite community of the plains killifish, Fundulus kansae, in the Platte River system in Nebraska was conducted to determine whether this group of organisms would show population fluctuations associated with streamflow and human alterations of the river. Study sites included several both above and below a major irrigation diversion. Several parasite types, including myxosporidan and peritrich protozoa, monogenetic trematodes, and larval digenetic trematodes, were studied. The parasite community was described in terms of species diversity and parasite frequency distributions among the host population. It was shown that some types of parasites responded to annual streamflow changes, regardless of study site, while others had population structures which were relatively site specific, regardless of the annual river conditions. Larval digenetic trematodes were considered the best 'indicator species' to reflect aquatic bird use of a particular study site.
W83-04155

7. RESOURCES DATA

7A. Network Design

LANDOWNERS, RECREATIONISTS, AND GOVERNMENT: COOPERATION AND CONFLICT IN RED RIVER GORGE,
Kentucky Water Resources Research Inst., Lexington.
E. C. Scott, and B. R. DeWalt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255448, Price codes: A07 in paper copy, A01 in microfiche. Research Report No 134, June 1982. 228 p, 6 Fig, 44 Tab, 36 Ref, 4 Append. OWRT A-079-KY(1), 14-34-0001-1119/0119/9019.

Descriptors: *Recreation facilities, *Institutional constraints, *Statistical analysis, *Population density, *Riparian rights, *Public waters, Recreation demand, Surveys, Canyons, Land tenure, Data collections, Riparian land, Property rights, Water rights, Legal aspects, Data acquisition, Data interpretation, Public participation.

A holistic sociocultural user survey study was made of the Red River Gorge, a popular regional recreation site in eastern Kentucky, to provide a descriptive and analytic information to assist managers in more effectively understanding and coping with their work in this area. Innovative ideas/techniques were also developed for the study of recreationists. Density tolerance (DT) curves were constructed for recreationists; DT being an important component of the measurement of social carrying capacity of such recreational areas. The most important finding was the development of the idea of recreational niches (RN). The results demonstrate that recreational areas like the Gorge may contain many different RN that are used in very different ways from other recreational sites in the same general setting. Further, characteristics of visitors using any RN may be quite different from those of visitors using other sites. The presence of RN in an area may bias the data collection unless data are collected in all types of niches. Using only one niche as representative of the entire recreating populace can lead to erroneous predictions concerning visitor characteristics/preferences, and may lead to inappropriate management. The RN concept can also be used by managers to encourage/discourage certain types of users, knowing the Rn variety. (Zienlinski - MAXIMA)
W83-03903

7B. Data Acquisition

EVALUATION OF A GROUND TRANSIENT ELECTROMAGNETIC REMOTE SENSING METHOD FOR THE DEEP DETECTION AND MONITORING OF SALT WATER INTERFACES,
University of South Florida, Tampa. Dept. of Geology.
M. T. Stewart, and M. C. Gay.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-253351, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 73, Univ. of Florida, Gainesville, July 1983. 47 p, 23 Fig, 43 Ref. OWRT A-046-FLA(1), 14-34-0001-2110.

Descriptors: *Geophysical surveys, *Salt water interfaces, Remote sensing, Coastal aquifers, Florida, Gulf Coast.

A ground transient electromagnetic sounding method was evaluated for the detection of salt water-fresh water interfaces along the Gulf Coast of FLorida. Seventy-nine sounding were completed utilizing either 80 x 80 meter or 160 x 160 meter horizontal transmitter coils. A 30 Hertz step function transmitter frequency was used. The decay of the vertical magnetic field was monitored over a period of 8 msecs during transmitter offtime. Measurements of the rate of decay of the magnetic field were converted to produce an apparent resistivity curve for each sounding. Computer produced theoretical curves were matched to the apparent resistivity curves. The results of this study are encouraging. The soundings compare favorably with chloride ion concentrations in area wells and with data from previous geophysical studies. An 80 x 80 meter coil is sufficient for sounding to depths of 250 meters. Depths and resistivities accurate to within plus-or-minus 10% of actual field values are possible. The transient electromagnetic method is safe, efficient, and economically attractive.
W83-03899

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF UNSATURATED SOILS WITH THERMOCOUPLE PSYCHROMETERS,
Texas Univ. at Austin. Geotechnical Engineering Center.
For primary bibliographic entry see Field 2G.
W83-04025

DETERMINATION OF SORPTIVITY BASED ON IN-SITU SOIL WATER REDISTRIBUTION MEASUREMENTS,
Southern Illinois Univ. at Carbondale. Dept. of Forestry.
For primary bibliographic entry see Field 2G.
W83-04044

AN IMPROVED THERMOCOUPLE HYGROMETER FOR IN-SITU MEASUREMENTS OF SOIL WATER POTENTIAL,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
O. Brunini, and G. W. Thurtell.
Soil Science Society of America Journal, Vol 46, No 5, p 900-904, September/October, 1982. 5 Fig, 15 Ref.

Descriptors: *Soil water, *Measuring instruments, Plant growth, Moisture availability, *Hygrometer,

Thermocouples, Water potentials, Plant water potential, *Soil water potential.

A new, improved thermocouple hygrometer for in situ soil water potential measurements is described which is based on the dewpoint theory and is operationally identical to the Neumann and Thurtell leaf hygrometer. The major design feature has been to minimize the temperature difference between the evaporating surface and the reference junctions. An initial test of the hygrometer in a soil-plant system and its performance when imposed on temperature gradients are evaluated. A porous silver membrane serves as the hydraulic connection between the soil and the measuring cavity, which encloses a four-terminal thermojunction made by cross welding chromel and constantan wires. The membranes were screwed to the copper body of the hygrometer; this configuration minimized the temperature difference between the vapor source and the reference junctions. When a thermal gradient was imposed on a hygrometer placed horizontally in a soil column, the maximum voltage offset observed was 0.05 microV, but the soil water potential values as indicated by the hygrometer readings remained constant at -0.56 MPa. The new device has a fast response for water flow with a time constant of about 5 min, and the time constant for salt diffusion in and out of the membranes is about 8 min. The device is able to follow changes in soil water potential very well, as demonstrated in soil water potential measurements under corn plant hybrid United 108 grown in a growth chamber environment. The difference in water potential noted between leaf and soil after the plant had been left several hours in the dark appeared to be related to uneven moisture distribution in the pot, and the plant was responding to the average soil water potential. (Baker-FRC)
W83-04070

ANALYSIS OF THE PLANT SOIL CONTINUUM USING ELECTROPHYTOGRAMS, PHASE II,
Arizona Univ., Tucson. Dept. of Electrical Engineering.
For primary bibliographic entry see Field 3F.
W83-04136

ANALYSIS OF CHEMISTRY ASSOCIATED WITH OZONOLYSIS OF ORGANIC POLLUTANT MOLECULES IN WATER,
Wesleyan Univ., Middletown, CT.
For primary bibliographic entry see Field 5A.
W83-04141

APPLICATION OF AERIAL PHOTOGRAPHIC AND COMPUTER ANALYSIS TO THE USLE FOR AREAWIDE EROSION STUDIES,
Texas Christian Univ., Fort Worth. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W83-04185

7C. Evaluation, Processing and Publication

FRACTURE TRACE MAPPING AND WATER WELL YIELD IN THE PIEDMONT REGION OF SOUTH CAROLINA,
Clemson Univ., SC. Dept. of Civil Engineering.
D. B. Stafford, J. T. Ligon, and D. S. Snipes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255471, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Publication No 112, Clemson Univ. S.C., August 1983. 66 p, 5 Fig, 19 Ref. OWRT A-033-SC(1), 14-31-0001-5041-6042, 4041.

Descriptors: *Aerial photography, *Infrared imagery, *Remote Sensing, *Groundwater, *Well yield, Well water, Water supply, Water supply development, Igneous rocks, Metamorphic rocks, Geologic fractures, Mapping, Photography, Fracture permeability, *South Carolina, Piedmont.

This report describes the techniques and the results of an extensive program of lineament and fracture trace mapping in the Piedmont Region of South Carolina. The lineaments and fracture traces were mapped on a variety of aerial remote sensor products including color infrared Landsat imagery, black and white infrared Landsat imagery, Skylab color photographs, high altitude color and color infrared photographs, black and white aerial photographs, and photo index sheets. It was concluded that an analysis of different types of aerial remote sensor products is needed to accomplish a thorough fracture trance mapping program. Also, it was determined that numerous lineaments and fracture traces exist in each county of the South Carolina Piedmont Region. A cooperative well drilling program undertaken in an effort to correlate well yield with fracture trace location was not entirely successful. Also, attempts to correlate well yield and well location with respect to mapped linear features met with only partial success. A continuing program of working with cooperative well drillers in an effort to generate additional data relating well yield and fracture trace location and further research to correlate well yield and fracture trace location are recommended in the Piedmont Region.
W83-03906

THE USE OF LANDSAT MSS DIGITAL DATA IN WATER QUALITY MAPPING OF THE NEUSE RIVER ESTUARY, N. C.,
North Carolina State Univ. at Raleigh.
S. Khorram, and H. M. Cheshire.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256750, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 193, May 1983. 36 p, 10 Fig, 5 Tab, 22 Ref. OWRT A-125-NC(1), 14-34-0001-2135.

Descriptors: *Remote sensing, *Satellite technology, *Estuaries, Water quality, Data collections, Aerial photography, On-site data collections, Data interpretation, *Water quality standards, Salinity, Chlorophysll A, Suspended solids, Turbidity, Temperature, Regression analysis, Statistical models, *North Carolina, Neuse River, *Landsat data.

Landsat multispectral scanner (MSS) digital data, and high resolution anoramic photography obtained from the Environmental Protection Agency's Enviropod were combined with surface measurements for water quality mapping of the Neuse River estuary, North Carolina. This study constitutes the first effort to use Landsat digital data for mapping water quality parameters in this geographic area. The water quality parameters of interest included salinity, chlorophyll a, turbidity and total suspended solids. Temperature data were also recorded on site. The approach involved acquisition of water quality samples from boats at 75 sample sites simultaneous with Landsat satellite overpass. All of the remotely-sensed data and boat-acquired data were obtained from 8:45 A.M. to 9:50 A.M. local time on September 24 1982. Regression models were developed between each of the salinity and suspended solids measurements from boats and the MSS digital data. The coefficients of determination (R) were observed to be high for salinity and turbidity, relatively high for salinity and turbidity, relatively high for chlorophyll a, and medium for total suspended solids. No quantitative assessment could be made of the water quality parameters by visual interpretation of aerial imagery. The results include a series of color-coded maps, each pertaining to one of the water quality parameters, along with the statistical summaries.
W83-03918

WATER QUALITY MONITORING - RIVERS AND STREAMS, 1981.
Indiana State Board of Health, Div. of Water Pollution Control Report, 1981. 139 p, 6 Tab.

Descriptors: *Water sampling, *Water analysis, *Water measurement, *Water pollution, *Water pollution control, *Water pollution effects, Water quality management, Water quality, Biological samples, Chemical analysis, Chemical composition, State jurisdiction, Municipal water.

This is the twenty-fourth annual water quality report on the major surface waters of Indiana. The program was established to provide basic information on pollution trends and to provide water quality data for surface water users in Indiana. The importance of surface water is emphasized by the fact that two-thirds of the water usage in Indiana in 1980 was obtained from surface supplies. While 49 sites were sampled in 1957, 92 stations are included in the current program. Physical, chemical, and bacteriological analyses are made on samples collected from all 92 stations; plankton analyses from 18; and radiological analyses from 26. The monitoring program is intended to indicate, when possible, the sources of pollution entering a stream, to procure data useful for multiple users and for future pollution abatement programs, and to collect background data on certain types of wastes, such as chlorides and radioactive materials. The monitoring stations are selected on the basis of having waters used for municipal, industrial, agricultural and recreational purposes; if they are near known or suspected sources of pollution; and when they are near state boundaries to determine the quality of water entering or leaving the state. Routine samples include 2,000 milliliters for chemical analysis and about 100 milliliters in a sterile bottle for bacteriological analysis. This year no flow data are included. The forty-one methods of analysis used are described. (Garrison-Omniplan)
W83-03993

GEOLOGIC MAP OF REDWOOD CREEK DRAINAGE BASIN, HUMBOLDT COUNTY, CALIFORNIA,
Geological Survey, Miami, FL. Water Resources Div.
D. R. Harden, H. M. Kelsey, S. D. Morrison, and T. A. Stephens.
Open-File Report 81-496 (WRI), 1982. 1 Sheet, 23 Ref.

Descriptors: *Geologic mapping, *Geologic fractures, *Watersheds, *Geomorphology, Sedimentary rocks, Metamorphic rocks, Alluvium, Landslides, Erosion, *California, California Coast Ranges, Klammath Mountains.

A 1:62,500-scale geologic map with 14 rock stratigraphic units and an accompanying explanatory text are used to describe the geology of the Redwood Creek drainage basin of northwestern California. A large part of Redwood National Park is located in the downstream part of this actively eroding drainage basin. The bedrock consists primarily of Mesozoic sedimentary and metamorphic rocks. The structurally complex Franciscan assemblage of rocks underlies most of the basin, but rocks of the Klammath Mountain tectonic province occurs in a small eastern part of the basin. Most major boundaries between Mesozoic rock units are north-northwest trending faults parallel to the regional structural trend. Extensive areas of surficial coastal plain sediments, landslide deposits, stream terrace deposits and modern alluvium are also present; these areas help identify loci of vigorous recent erosion. (USGS)
W83-04012

A STATISTICAL ANALYSIS OF THE QUALITY OF SURFACE WATER IN NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
R. A. Engberg.
Water-Supply Paper 2179, 1983. 252 p, 14 Fig, 9 Tab, 19 Ref.

Descriptors: *Water quality, *Surface water, *Chemical analysis, *Biological properties, Streamflow, River basins, Sampling, Sites, Water analysis, Regression analysis, Correlation analysis, Specific conductivity, Planning, Water quality control, *Nebraska.

This report provides descriptive statistics for 29 chemical or biological constituents for 109 stream sites in Nebraska sampled by the U. S. Geological Survey beginning in 1946. Also provided for each site are regression equations relating specific conductance to each of 12 chemical constituents and a regression equation relating specific conductance

to stream discharge. The descriptive statistics are presented by river basins. Water leaving these basins that has the lowest mean specific conductance (266 umho/cm) is from the Niobrara River at Verdel, and water that has the highest (1,890 umho/cm) is from the South Platte River at Roscoe. Statewide, the principal cations in streamflow are calcium and sodium, and the principal anions are bicarbonate and sulfate. Calcium and bicarbonate usually predominate where the mean exceeds 1,000 umho/cm. Based on regression equations, dissolved solids, hardness, calcium, magnesium and bicarbonate, with some exceptions, correlate well with specific conductance for all stream sites. Illustrations of how regression equations may be used to estimate water quality of streamflow are given and are compared with values from actual analyses. (USGS)
W83-04014

USE OF DIGITIZED RADAR AND MICROCOMPUTERS TO FORECAST LOCAL FLOODS AND IRRIGATION NEEDS,
Clemson Univ., SC. Dept. of Civil Engineering.
S. Nnaji, D. F. Linvill, and K. D. Robbins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-105568, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Publication No 113, Clemson Univ., SC, June 1983. 80 p, 8 Fig, 2 Tab, 27 Ref, 1 Append. OWRT A-054-SC(1), 14-34-0001-2143.

Descriptors: *Microcomputer, *Radar, *Flood forecasting, *Irrigation scheduling, *Data collection, *Data storage and Retrieval, *Data transmission, Antecedent moisture, Excess rainfall, Rainfall rate, Discharge hydrographs, Decision making, Throughfall, Computer programs.

The objective is to develop an inexpensive microcomputer based system for making weather sensitive decisions in real time. The focus is toward the small scale weather information user. To this end the report describesa Radar Information Management System which uses a microcomputer to access, reformat, localize, store and retrieve radar rainfall (or other weather) data in a digitized form. The system will also produce a facimile on command. In addition to the system software, interactive applications software have been developed that will allow use of the system for local flood forecasting and assessment of irrigation needs given soil moisture predictions based on real time radar rainfall. A system implementation procedure and sample outputs are included.
W83-04158

8. ENGINEERING WORKS

8A. Structures

FINANCIAL ASPECTS OF DAM SAFETY,
International Bank for Reconstruction and Development, Washington, DC.
F. L. Hotes.
International Water Power and Dam Construction, Vol 35, No 1, p 37-38, January, 1983.

Descriptors: *Dam design, *Financing, *Safety, Dam construction, Dam stability, Economic aspects, Maintenance, Inspection, Monitoring.

In 1977, the World Bank updated its requirements for the design, construction, and inspection of dams that it helps to finance. The builders must have the concept and design of the dam reviewed by an independent panel of experts during the early and final stages of construction, and periodic safety inspections must be carried out by qualified independent experts. Adequacy of design includes the incorporation of appropriate monitoring equipment to check dam functions after construction. The cost of inspection panels may be considered for financing under the loan. A maintenance program may involve designing a manual of inspection directives and training a staff to carry them out. The use of a review panel has not been universally accepted in all nations, even in developed countries such as the United States. Sometimes the conclusions of the expert panel are not acceptable to the World Bank. Further discussions and inquiries might be required before a loan for a dam is approved. (Geiger-FRC)
W83-04078

LARGE CAPACITY BULB UNITS IN JAPAN,
Fuji Electric Co. Ltd., Kawasaki (Japan). Hydro Power Div.
For primary bibliographic entry see Field 8C.
W83-04166

EXPERIENCE IN THE USE OF ROLLED CONCRETE,
Ministry of Construction, Tokyo (Japan). River Bureau.
For primary bibliographic entry see Field 8F.
W83-04169

8B. Hydraulics

GROUND WATER PUMPING FROM SHALLOW AXISYMMETRIC PONDS,
Georgia Inst. of Tech., Atlanta. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W83-03863

MULTIPORT DIFFUSERS FOR HEAT DISPOSAL: A SUMMARY,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
G. H. Jirka.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY12, p 1425-1468, December, 1982. 25 Fig, 2 Tab, 47 Ref.

Descriptors: *Cooling water, *Diffusers, *Fluid mechanics, Powerplants, Mixing, Multiport diffusers, Thermal powerplants, Thermal water, Plumes, Water circulation, Stagnant water, Water currents, Stratified flow, Fate of pollutants, Wastewater disposal, Outfall, Nozzles.

The fluid mechanical characteristics of submerged multiport diffusers, used to disperse hot water discharges from thermal power plants, are reviewed. Near-field mixing of a thermal diffuser is strongly influenced by its momentum flux, whereas mixing of a sewage diffuser is governed by buoyancy flux. Unlike sewage diffusers, which form a buoyant plume, thermal diffusers produce instability in the near field, leading to a flow breakdown with local recirculation and full vertical mixing. The flow and temperature fields in the intermediate field depend on how the discharge momentum is introduced into the ambient fluid layer. Three major types of diffuser designs have evolved. The staged and unidirectional diffusers produce concentrated vertically mixed plume motions. The alternating diffuser generates a stratified flow field outside the unstable near field. Predictive techniques are given for the three types both for the stagnant ambient case and for the additional influence of a current system. A sample design is given for a 2000 MW nuclear power plant located in a site typical of the East or Gulf Coasts or the Great Lakes. For this problem the required diffuser length was greatest for alternating, least for unidirectional, and intermediate for staged. Impacts on the environment and mixing patterns are described for stagnant and running water. (Cassar-FRC)
W83-03864

SEDIMENTOLOGY OF ERECT VEGETAL FILTERS,
Georgia Univ., Athens. Dept. of Agricultural Engineering.
E. W. Tollner, B. J. Barfield, and J. C. Hayes.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY12, p 1518-1531, December, 1982. 10 Fig, 1 Tab, 18 Ref.

Descriptors: *Sediment transport, *Vegetation effects, *Filter media, Grasses, Model studies, Channel flow, Shear, Bed load.

A method for calculating the steady state sediment transport rate through a vegetated channel was developed using an analogy between a narrow deep open channel and flow through closely spaced erect objects. A dimensionless bed shear parameter was predicted using a spacing hydraulic radius in which media spacing was substituted for channel width. This shear parameter was used in Einstein and Graf sediment transport equations and in Neil's relationship to describe the initiation of sediment motion. Correlation values were 0.81-0.94. Predicted and observed values for movement of sediment in grasses agreed very well. (Cassar-FRC)
W83-03865

HYDRAULICS AND NUMERICAL SOLUTIONS OF STEADY-STATE BUT SPATIALLY VARIED DEBRIS FLOW,
Utah Water Research Lab., Logan.
A. A. DeLeon, and R. W. Jeppson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256719, Price codes: A06 in paper copy, A01 in microfiche. Hydraulics and Hydrology Series UWRL/H-82/03, July 1982. 95 p, 24 Fig, 10 Tab, 35 Ref. OWRT A-053-UTAH(1), 14-34-0001-1147.

Descriptors: *Debris flow, *Open channel flow, Mud flow, *Flow density, *Flow viscosity, Energy loss, Fluid mechanics.

The debris flows that occur periodically in steep, narrow mountain canyons are very destructive. Engineered design and land use management in affected areas requires quantification of flows and inundated areas through hydraulic formulas. Specifically, debris flow is triggered by high intensity rainfall, loose surface material available for transport, slopes steep enough to induce flowage, and insufficient vegetation. The two hydraulic models currently available (Bingham plastic model and dilatant model) were found to be not very useful in practice. According to field data, most debris flows are laminar because of viscosities as high as 600,000 times that of water. A theoretical derivation starting from the Saint-Venant equations of continuity and motion, when combined with a modified Chezy equation, C=1.85 R sub e super 0.52, for defining the energy loss, gave a relationship, rho/mu = 3/R, found suitable. These equations successfully applied to four examples situations by numerical methods implemented in a computer program. The examples were all steady but gradually varied debris flow situations. The bed slope was found to be the most important variable affecting the ratio of debris flow to water flow depth with ratios for mild slopes exceeding 10.
W83-03914

JOHNSON VELOCITY METER SYSTEM PROVES ITS WORTH,
UOP, Inc., St. Paul, MN. Johnson Div.
D. C. Larson.
Johnson Driller's Journal, Vol 53, No 1, p 6-7, 1981. 1 Fig.

Descriptors: *Pumping tests, *Aquifer testing, *Flow velocity, Well yield, Measuring instruments, Flow measurement.

The Johnson velocity meter system is a turbine-type flowmeter used to measure vertical flow velocity in pumping wells. A flow vs. depth graph shows the upper and lower limits of the water bearing formation. Use of the tool is illustrated in a water well velocity survey conducted in a well 315 ft deep. In this case the most productive zone was between 205 and 235 feet. (Cassar-FRC)
W83-04076

8C. Hydraulic Machinery

BIPHASE TURBINE FOR REVERSE OSMOSIS DESALINATION,
Transamerica Delaval, Inc., Santa Monica, CA. Biphase Energy Systems.
P. L. Limburg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-255513,

Price codes: A04 in paper copy, A01 in microfiche. Completion Report, December 1982. 49 p, 18 Fig, 7 Tab, OWRT C-10121-S(No 1487)(1), 14-34-0001-1487.

Descriptors: Power recovery, *Turbines, *Reverse osmosis, Hydraulic turbines, *Desalination, Turbine efficiency.

A new hydraulic reaction turbine was designed to recover the power available in the high-pressure waste-brine stream of reverse osmosis desalination systems. A reaction turbine sized for reverse-osmosis systems producing 600 gph was built and tested. The turbine performed well driving either a variable-speed pump or an electrical generator. Measured turbine efficiency (shaft power divided by available power) was 63%, compared with a prediction of 67%. The turbine can be built with larger capacity to reduce the size, weight and power consumption of reverse osmosis desalination systems. Efficiency of larger units is predicted to lie in the range of 65 to 70%.
W83-03910

MULTIPORT DIFFUSER DESIGN FOR DISCHARGING POLLUTANTS IN ALABAMA'S RIVERS,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
A. D. Parr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-256693, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Auburn Univ., Ala., April 1983. 6 p. OWRT A-077-ALA(2), 14-34-0001-0101.

Descriptors: *Diffusion coefficient, Environmental effects, *Mathematical models, Plumes, Rivers, Water pollution, *Wastewater disposal, *Flow discharge, *Alabama.

A laboratory study was conducted to measure surface temperatures downstream from a submerged multiport river diffuser. An empirical equation was developed which considers the physical variables and predicts downstream temperatures. The flowfield induced by a submerged multiport diffuser discharging across part of the width of a river was considered. A mathematical model was formulated for the flow in the nearfield region of a diffuser plume centered in a rectangular channel. The model was used to determine nearfield dilution as a function of effluent and ambient flow parameters. A family of dilution curves was presented for a range of conditions characteristic of prototype river diffusers. A method was given for applying the mathematicl model to diffuser-induced flow-fields in rivers. The model was also compared with measurments made in the Mississippi River downstream from the Quad Cities Nuclear Power Station diffuser. Design procedures to optimize finite length river diffuser performance were developed. Computer programs were written to facilitate necessary design calculations.
W83-03912

MECHANICAL CLEANING EQUIPMENT FOR STORMWATER BASINS (MASCHINELLE RAUMEINRICHTUNGEN FUR REGENBECKEN),
Rheiner Machinenfabrik Windhoff A.G. (Germany, F.R.).
R. Wischner.
Wasser, Luft und Betrieb, Vol 24, No 6, p 16, 18-20, June, 1981. 5 Fig, 6 Ref. (No English Summary).

Descriptors: *Storm water, *Retention basins, *Cleaning, *Hydraulic equipment, *Detention reservoirs, Storm runoff, Insects, Odor control, Rain basins, Cleaning equipment, Sprays, Design criteria, Water pollution control, Construction materials, Reservoirs, Storage tanks, Maintenance, Basins, Closed basins.

Cleansing systems for rainwater collection, overflow, and treatment basins are described. In principle, a self-cleaning basin is preferred, but high construction costs (e.g., for floor profiling) and the need for the surrounding terrain to meet certain hydraulic conditions make mechanical cleaning more practical. The deposited matter to be removed is mostly of mineral origin (e.g., sand, gravel) but contains variable amounts of organic matter. When the basin is dry, the deposits soon decompose, resulting in malodorous conditions. Thus it is necessary for cleaning equipment to start operating automatically immediately after rainfall begins and the water level rises. The cleaning plates are a determining factor for performance level: for rectangular basins, heavy sheet-steel, plough-shaped plates with rollers or skids are employed; while for round basins, because deposits must be removed via a central funnel, steel plates with a logarithmic spiral or fan shape are required. Since the cleaning plates cannot remove floating matter that adheres to the basin walls, and because sludge residues can remain on the basin floor after cleaning, a supplemental spray cleaning device is essential. To ensure that the cleaning system starts up at the appropriate time, a water-level-dependent control system must be used. A second control system is required to switch the cleaners on periodically during dry spells (to prevent odors and flies). For closed rectangular rain basins, longitudinal cleaners attached to a continuous cable line are used. The entire cleaner is under ground and runs on a track along the basin sides. For round basins, an underground cleaner with central drive mechanism mounted above the basin on a bridge is used. For large round basins with a central concrete support, the drive mechanism is located decentrally. (Gish-FRC)
W83-03942

WATER CONTROL BY AUTOMATIC GATES,
U. Berar.
International Water Power and Dam Construction, Vol 35, No 1, p 35-37, January, 1983. 3 Fig, 1 Tab.

Descriptors: *Mathematical models, *Hydraulic gates, *Weirs, *Irrigation canals, Model studies, Mathematical studies, Canals, Hydraulic equipment, Hydraulic machinery, Automation.

A mathematical model simulating the movement of an automatic gate operating at a constant upstream level and under differing water demands is being developed in Romania. This model will lead to a more detailed knowledge of the process which takes place in the canal section close to the gate zone and allow improvements to be made in the mechanism or the operating regime of the canals equipped with automatic gates. The model elaborates conditions similar to reality and is based on the average state of the system for calculating the essential balance of energy involved in the process, assuming that a certain general relationship exists between the balanced terms. This model simulating the movement of the hydraulically adjusted gated weir is a useful tool in dimensioning of water delivery systems. When the model is applied in choosing a weir type and monitoring its effects during operation, the calculations must be carried out by a computer. (Geiger-FRC)
W83-04079

LARGE CAPACITY BULB UNITS IN JAPAN,
Fuji Electric Co. Ltd., Kawasaki (Japan). Hydro Power Div.
T. Ueda.
International Water Power and Dam Construction, Vol 35, No 3, p 19-24, 1983. 10 Fig, 1 Tab, 2 Ref.

Descriptors: *Hydroelectric power, *Economic aspects, *Dam design, *Turbines, *Damsites, *Electrical equipment, Dam construction, Hydraulic equipment, Dams, *Tidal powerplants, *Japan.

Few economically favorable hydropower sites remain in Japan. However, if small plants of less than 10 MW capacity were to be exploited, then 5400 MW might be developed over the next ten years. The Akao power station typifies an economical low-head site. Its dam impounds 600,000 cu m of the Sho river and utilitizes a bulb turbine. The Sakuma 2 station was constructed to exploit a 15.5 m head. Its powerhouse is partially underground, and two vertical upper and lower stayvanes and four auxiliary stayvanes support the bulb in which the generator is housed. The Shingo 2 station, constructed in parallel with the existing Shingo station on the Agano river, has a miximum capacity of 38.8 MW at a maximum discharge of 200 cu m/sec. The generating unit has a record-breaking high-head large-capacity bulb turbine, and the structural design of the turbine and generator is basically the same as that of the Akao station. The technology of large-capacity bulb turbines and generators may be exploited in the future for the development of tidal power generation. (Geiger-FRC)
W83-04166

OPTIMUM CAPACITY OF A RUN-OF-RIVER PLANT,
International Engineering Co., Inc., San Francisco, CA.
F. Fahlbusch.
International Water Power and Dam Construction, Vol 35, No 3, p 45-48, 1983. 3 Fig.

Descriptors: *Stochastic process, *Mathematical studies, *Model studies, *Optimization, *Decision making, *Hydroelectric power, Stochastic hydrology, Prediction, Planning, Hydroelectric plants, Streamflow, Monte Carlo method.

A run-of-river plant may be viewed as a system which converts a stochastic input process, streamflow, into a stochastic output process, power. As a result of the stochastic nature, an approach is needed to determine the capacity which allows for uncertainty, especially where decision making involving risks must be used. An approach is introduced which provides an exact formulation which is simple to implement and provides valuable guidance in weighing the possible effects of imprecise cost and benefit data on the design capacity. The objective function has the typical structure of the objective functions describing single-period inventory decision problems under risk. The theory and results may be applied to any hydro plant, with or without pondage, if the objective is maximum exploitation of energy and not provision of peak capacity. A maximization of net benefit is used as evaluation criterion. Equations are derived which provide sufficient conditions for determining the optimum capacity, whether or not the project as a whole exhibits a favorable economic performance. The Monte Carlo method was used to extend the method by simulating hypothetical projects for smaller watersheds. (Geiger-FRC)
W83-04167

CHARACTERISTICS OF GENERATORS FOR SMALL CAPACITY SCHEMES,
Meidensha Electric Mfg. Co. Ltd., Tokyo (Japan). Hydraulic Power Generation Div.
S. Miyakawa.
International Water Power and Dam Construction, Vol 35, No 3, p 36-40, 1983. 6 Fig.

Descriptors: Electrical equipment, *Hydroelectric plants, *Hydraulic turbines, Hydraulic machinery, Hydraulic equipment, Construction costs, Turbines, *Thailand, *Indonesia.

Horizontal type turbine-generators are being used increasingly for small scale hydro to reduce construction costs and to simplify the layout of equipment and construction. These types of generators have stator coils insulated by an r.t. insulation system which uses vacuum pressure impregnation. Their standard exciting system is the brushless type, and the generator bearings are designed to support the hydraulic thrust force and the weight of the turbine runner. Rotors can be of the salient pole type or the cage type. The main shaft is made of rolled or forged steel, and the flywheel is made of steel plate or cast steel. The guide bearings and thrust bearings are installed together on the direct coupling side. Where a two-bearing type is adopted, a brake unit is installed between the exciter and the outside of the bearing. The brushless exciter is a current trend for easy maintenance. The Batang Agam station in Indonesia and the Mae Kum Luang station in Thailand are two horizontal type turbine-generator units currently in operation. (Geiger-FRC)
W83-04168

THE PROBLEMS AND BENEFITS OF SMALL-SCALE HYDRO (PART 2).
For primary bibliographic entry see Field 6C.
W83-04170

8D. Soil Mechanics

MATERIAL FOR EMBANKMENT DAMS,
A. D. M. Penman.
International Water Power and Dam Construction, Vol 35, No 1, p 15-19, January, 1983. 2 Fig, 24 Ref.

Descriptors: *Rock fill, *Earth dams, *Dam design, *Dam foundations, Rockfill dams, *Embankments, *Mine wastes, Soil mechanics, Dams, Dam construction, Earthworks, Materials engineering, Fly ash.

Embankment dams remain the most frequently built dams today due to their low construction costs and aesthetic properties. Rockfill material is usually more suitable for higher embankment dams. Modern rockfill, placed in layers and compacted by vibrating, ensures minimum contact forces by providing abundant fines. Control of rockfill placement is measured by the compaction meter. The shear strength of rockfill is defined by the angle of shearing resistance. The use of rockfill has made upstream membrane dams popular. Well graded sand and gravel can provide good shoulder fill, as illustrated by new rockfill dams in the Soviet Union, Canada, and Scotland. Earthfill of soft silty clay is often used for the shoulders of dams. A combination of weak shoulder fill and low-strength foundation can lead to the formation of very flat slopes, which may be used for farming or other purposes. Embankment dams have traditionally been fitted with cores of compacted earthfill of low permeability, such as bituminous concrete. Waste materials such as metal tailings, fly ash, and furnace bottom ash have also been used for embankment dam materials. Embankment dam behavior has been analyzed by numerical models, finite element techniques, and one-dimensional compression tests. (Geiger-FRC)
W83-04081

10

THE USE OF GEOTEXTILES IN FRENCH EARTH DAMS,
Ministere de l'Agriculture, Paris (France).
D. Loudiere, D. Fayoux, J. Houis, J. Perfetti, and M. Sotton.
International Water Power and Dam Construction, Vol 35, No 1, p 19-21, January, 1983. 4 Fig, 2 Tab.

Descriptors: *Earth dams, *Dam design, *Earthworks, *Soil filters, *Performance evaluation, Dam construction, Dams, Materials engineering, Soil mechanics, Filters, Dam stability.

Geotextiles are used in earth dam construction to guard contamination and for filtration, drainage, strength, containment, and separation. Geotextile materials may be classified as woven or non-woven materials or composite geotextiles. Durability tests of various geotextiles were conducted on samples taken from two earth dams in France. For all civil engineering applications, after ten years' use, the reduction in mechanical performance of geotextiles was not more than 30% under normal use conditions. The French Committee on Geotextiles has drafted a matrix table to classify properties of geotextiles according to tensile strength, elongation load, and tear strength. When geotextiles are used as filters, some designers recommend tests to demonstrate that there is no incompatibility between the geotextile and the soil. Since these tests are time-consuming, it is often more logical to use filter rules based on the intrinsic properties of the geotextile and the soil. Interim rules based on an analogy with Terzaghi's rules and long-term tests at Cemagref are suggested; these do not apply to gap-graded, evolutive or dispersive soils. Other areas in which geotextiles may contribute to good dam performance relate to cracking, earthquake-resistance and rapid drawdown. (Geiger-FRC)
W83-04082

8F. Concrete

ASPHALTIC CONCRETE MEMBRANES IN EMBANKMENT DAMS,
Binnie and Partners, London (England).
R. A. Bunn.
International Water Power and Dam Construction, Vol 35, No 1, p 22-24, January, 1983. 4 Fig, 4 Ref.

Descriptors: *Dam construction, *Concrete dams, *Dam design, *Embankments, *Concrete technology, Dam foundations, Asphalt, Membrane filters, Rockfill dams, Earth works, Dam stability.

Bituminous materials have been successfully used for many years as waterproofing structures in embankment dams. Asphaltic concrete membranes are costly but durable and have withstood the effects of sun and high temperatures as well as frost and low temperatures. The face length which can be laid from one working elevation is limited to about 150 m. The outer face of the embankment should be constructed on a crushed, well graded, permeable rockfill. The first layer of asphaltic concrete is a leveling and binder course. In the 1950's and 1960's, monitoring of leakage was done by placement of a drainage layer, and a seal coat was applied to the facing to protect against the elements. The toe structure should be kept as low as possible above the adjacent embankment foundation level, and it may contain a drainage gallery to monitor seepage. Construction of the facing is done in conjunction with weather conditions. Seven dams over 50 m in height have been constructed with a dense asphaltic core as the sole waterproofing membrane. Transition material on either side of the core creates a stable working surface for the construction plant and binds the core to the coarser embankment fill. Two machines have been developed to construct the cores. Each delivery of the constituent materials should be tested for physical properties. For facing membranes, the stability of the dense mix should be checked at regular intervals. (Geiger-FRC)
W83-04083

EXPERIENCE IN THE USE OF ROLLED CONCRETE,
Ministry of Construction, Tokyo (Japan). River Bureau.
T. Hirose.
International Water Power and Dam Construction, Vol 35, No 3, p 40-44, 1983. 5 Fig, 3 Tab, 5 Ref.

Descriptors: *Dam construction, *Concrete technology, *Concrete dams, *Construction methods, Construction materials, Gravity dams, *Japan, Concrete, Dam design, Construction costs.

The construction of modern concrete dams in Japan has been practiced for over one hundred years due to improvements in construction equipment, rationality of design, and the suitability of materials. In 1974, a Committee on Research Concerning Rationalized Construction of Concrete Dams was established, and in 1978, study groups were formulated to examine the rolled concrete method for the construction of the Shimajigawa and Ohkawa dams. Problems with the construction of concrete dams in Japan include crack formation, labor problems, and an abundance of cement unsuitable for dam construction. During the construction of the Shimajigawa dam, a stationary cableway and dump trucks were used due to topographical limitations. By using the rolled concrete method in constructing the Ohkawa dam, a three to four times greater unit placement volume could be achieved compared with the conventional block method. The control of moisture content was facilitated by radioisotopes during dam construction. Labor costs were reduced by the use of machinery. At the raising of the Shin-Nakano dam, the rolled concrete method was chosen for its economy and ease of placement. The rolled concrete method may be suitable for the construction of gravity dams if certain problems are solved. The River Bureau of the Ministry of Construction is currently investigating this method of construction. (Geiger-FRC)
W83-04169

8G. Materials

LEVASINT COATINGS. LONG-TERM CORROSION PREVENTION INCLUDES THE WATER FIELD (LEVASINT-BESCHICHTUNGEN. LANGZEIT-KORROSIONSSCHUTZ AUCH FUR DEN WASSER-BEREICH),
Bayer A.G., Leverkusen (Germany, F.R.).
J. A. Aziz El Sayed.
Wasser, Luft and Betrieb, Vol 25, No 3, p 34-35, March, 1981. 4 Fig, (No English Summary).

Descriptors: *Coatings, *Pipes, *Water tanks, *Corrosion control, Wastewater treatment, Water treatment, *Levasint coating, Metals, Linings, Corrosion, Deterioration, Standards, Physical properties, *Federal Republic of Germany.

The physical properties, methods of application, and areas of use for Levasint a corrosion preventive coating for metal equipment, are described. Levasint coating is especially suited to use in the water and wastewater treatment fields, since it poses no health hazards. Levasint is a powder based on an ethyl-vinyl alcohol copolymer and contains no additives other than pigments. It has been used successfully for over 10 yr. Before application, the metal surfaces to be coated should be roughened by blasting with a sharp-edged medium. Methods of applying Levasint include the centrifugal sintering procedure, spraying with a powder spray gun, flame spraying, and the filling and rotation sintering methods. Levasint coating adheres well to metal surfaces and conforms to the Federal Republic of Germany's standards for use in the food and drinking water industries. It does not promote the growth of bacteria and microorganisms and is wear-resistant, so that water with a high solids content does not damage it. Its smooth surface prevents incrustation. It can be used with water of pH 1-14, and in underground applications has proved not to be affected by soil composition. The coating provides metal equipment with good electrical insulation. Levasint has been used in sludge and aeration basins for over 10 yr and in the general wastewater treatment area for over 5 yr. It is also used for equipment in drinking and industrial water treatment. (Gish-FRC)
W83-03939

EMBANKMENT DAMS WITH POLYETHYLENE AND STEEL MEMBRANES,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Moscow (USSR).
V. D. Glebov, and V. S. Kuznetsov.
International Water Power and Dam Construction, Vol 35, No 1, p 25-28, January, 1983. 4 Fig, 3 Ref.

Descriptors: *Embankments, *Dam construction, *Polymers, *Impervious membranes, *Materials engineering, *Steel, Dams, Dam design, Membranes, Materials testing, Performance evaluation, Waterproofing.

Polymer film watertight elements are becoming major materials for waterproofing embankments due to their substantially lower cost, reduced labor requirements, and ease of handling. The Atbashi dam and the Tortgul reservoir of the Soviet Union employ polymer film waterproofing. Required film element thickness is calculated from soil grain size for a continuous foundation and from flexure of girderless slabs or membrane behavior for a discrete foundation. Film elements are subject to additional tensile stresses induced by foundation settlement, cracks or other internal defects. Polyethylene films are used as watertight blankets in the Soviet Union to withstand sub-zero temperatures. The use of steel membranes at Serebryanskaya-2 and Norilskaya dams has allowed the dams to operate reliably for years in sub-zero temperatures. Special corrosion protection prolongs the life of steel membranes in dams. Procedures were developed for stress analysis and for calculating the membranes' horizontal movements. Experience gained during construction has led to recommendations for installing different membrane types and for placing soil into the side shells and filter zones of dams. (Geiger-FRC)
W83-04077

THE SEISMIC BEHAVIOUR OF GRAVITY DAMS FOUNDED ON LOW SHEAR STRENGTH SOIL,
Engineering and Consulting Co., Belgrade (Yugoslavia). Dept. of Underground Structures.
I. V. Tucovic.
International Water Power and Dam Construction, Vol 35, No 1, p 28-31, January, 1983. 5 Fig, 5 Ref.

Descriptors: *Dam stability, *Seismic properties, *Materials engineering, *Concrete dams, Gravity dams, Dams, Dam construction, Earthquake engineering, Clays, Polymers, Dam foundations.

The need for energy and large fertile areas with water control often forced engineers to place gravity dams in seismis zones having foundation soils characterized by low shear strength. For gravity dams, the acceptable siesmic effect should be based on the amount of differential movement which will not jeopardize the structural integrity of the dam. This should include the maximum credible earthquake conditions based on the relevant earthquake record for the dam location. The contact surfaces between the monoliths and the embankment represent the most delicate part of the dam. Joint fillers must be selected to ensure proper placement, have a small resistance to volume changes, and contribute to water tightness. Bentonite and polystyrene may be used as joint fillers, but the latter disintegrates with time. Typical contact surfaces which are already in operation are discussed. Contacts within the concrete parts in a dam in Iraq feature a bentonite plug sealer and two polyvinyl chloride waterstops. A joint between the contact headwork and chute contains a copper sheet waterstop and a protective cap of stainless steel. A circular bentonite cushion and a polyvinyl chloride waterstop provide a sealing for the junction of the concrete dam and access shaft which can accommodate differential movements. The upper part of the shaft is reinforced against asymmetric bentonite pressure which could occur during sliding. (Geiger-FRC)
W83-04084

A U.S. TEST FOR INSITUFORM; OR, HOW TO REBUILD PIPE FROM WITHIN,
South Daytona Dept. of Building and Engineering, FL.
R. Owens.
American City and County, Vol 95, No 9, p 40-41, September, 1980.

Descriptors: *Sewers, *Repair, *Insituform, *Infiltration, Daytona Beach, Florida, Soil water movement, Maintenance, Pipes.

Due to the high water table, infiltration is a major problem in sewer systems of Daytona Beach and South Dayton, Florida. Having found through cost estimates that slip lining would be too expensive a method to restore sewer lines, the installation of Insituform was agreed upon. The job involved lining 2455 ft of 15-in pipe, 3616 ft of 12-in pipe and reconnecting 112 service laterals. The process uses a flat, flexible polyester fiber belt tubing, lined on one side with polyurethane and impregnated with a liquid, thermal-setting catalyzed resin at the time of installation. Before it is injected into the liner, resin is mixed with peroxide. The prewetted liner is fed to the top of scaffold from a truck. As the liner is fed through an inversion tube, a cover protects it from the direct rays of the sun. Curing is an important factor, with a 15-in line, 300 ft long, taking about 16 hr to cure completely. After curing, lateral connection cutting is mnitored. Renewal of the system took 3 months' time and reduced the flows to the treatment plant by more than 200,000 gpd. The cost was $265,000. (Baker-FRC)
W83-04130

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

HYDROLOGIC STUDIES OF THE U. S. GEOLOGICAL SURVEY IN MAJOR COAL-RESOURCE AREAS OF UTAH THROUGH 1980,
Geological Survey, Salt Lake City, UT. Water Resources Div.
G. C. Lines.
Open-File Report 81-216, February 1981. 20 p, 4 Fig, 1 Plate.

Descriptors: *Bibliographics, *Surface water, *Groundwater, *Coal mining, Groundwater availability, Data collections, *Utah.

Hydrologic studies in and near the major coal fields of Utah by the U.S. Geological Survey through 1980 are described. The report is intended as a reference for those people dealing with coal-related hydrologic problems. In an annotated bibliography, 47 reports that deal with many components of the hydrologic system are summarized. Most of the reports are interpretive in nature, but some contain only basic data. The reports deal with such varied subjects as the magnitude and frequency of floods, the availability of ground water, and the hydrologic impacts of coal mining. Seven hydrologic studies that are active in 1980 in Utah coal-resource areas are described. That part of the Geological Survey statewide network for monitoring surface water and ground water that is in the vicinity of the major coal fields also is described. (USGS)
W83-04015

SUBJECT INDEX

ACCUMULATION
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

ACETYLCHOLINESTERASE
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

ACID MINE DRAINAGE
Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

ACID RAIN
Assessment of Acidity of Lakes and Precipitation in the Sierra Nevada,
W83-03911 5B

1982 Stockholm Conference on Acidification of the Environment,
W83-04095 5B

Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

ACIDIC WATER
Zooplankton Diversity and Biomass in Recently Acidified Lakes,
W83-04103 2H

Low pH and the Absence of Fish Species in Naturally Acidic Wisconsin Lakes: Inferences for Cultural Acidification,
W83-04108 5C

ACTIVATED CARBON
Biological Regeneration of Activated Carbon,
W83-04133 5D

ACTIVATED SLUDGE
Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

ACTIVATED SLUDGE PROCESS
The Jet Nozzle--A New Submerged Aerator (Die Strahlduse--Ein Neuer Tauchbelufter).
W83-03926 5D

Effective Use of STOM,
W83-03931 5D

Aspects of the Performance of Final Clarifiers in the Activated Sludge Process,
W83-03951 5D

Biochemical Changes Associated With Luxury Phosphate Uptake in a Modified Phoredox Activated Sludge System,
W83-03953 5D

Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

The Location and Nature of Accumulated Phosphorus in Activated Sludge,
W83-03955 5D

Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

ACTIVATED SLUDGE PROCESSES
Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

ADSORPTION
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

Adsorption of Radium-226 by Biological Origin Absorbents,
W83-04114 5D

A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

ADVANCED WASTEWATER TREATMENT
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

AERATION
Energy-Efficient Aeration of Activation Basins (Energiefreundliche Beluftung Von Belebungsbecken),
W83-03925 5D

Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

AERATORS
The Jet Nozzle--A New Submerged Aerator (Die Strahlduse--Ein Neuer Tauchbelufter).
W83-03926 5D

AERIAL PHOTOGRAPHY
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

AEROBIC DIGESTION
Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

AEROBIC TREATMENT
Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

AGRICULTURAL RUNOFF
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

AGRICULTURAL WATERSHEDS
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

AGRICULTURE
Some Aspects of the Present Status of Algae Cultivation and Their Application (Nekotorye Aspekty Sovremennogo Sostoyaniya Kul'Tivirovaniya Vodoroslei I Ikh Primenenie),
W83-04073 5D

Purification of Faecal Waters Combined with Algal Protein Production (Ochistvane Na Vodi S Fekalen Kharakter, Suchetano S Poluchavane Na Vodoraslov Protein),
W83-04074 5D

Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

AIR POLLUTION
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

ALABAMA
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

ALGAE
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

Some Aspects of the Present Status of Algae Cultivation and Their Application (Nekotorye Aspekty Sovremennogo Sostoyaniya Kul'Tivirovaniya Vodoroslei I Ikh Primenenie),
W83-04073 5D

Purification of Faecal Waters Combined with Algal Protein Production (Ochistvane Na Vodi S Fekalen Kharakter, Suchetano S Poluchavane Na Vodoraslov Protein),
W83-04074 5D

Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

ALGAL BIOASSAY
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

ALGAL GROWTH STAGES
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

ALGAL TOXINS
Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

ALUMINUM
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

AMMONIA
Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

ANAEROBIC DIGESTION
Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

AQUATIC BIOTA
Relationship Between Body-Lead Concentration of Mysis Relicta and Sediment-Lead Concentration in Kootenay Lake, B.C.,
W83-04104 5C

AQUATIC HABITATS
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

AQUATIC INSECTS
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

AQUATIC LIFE
Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms,
W83-03877 5C

Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

AQUATIC PRODUCTIVITY
Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

AQUIFER
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

AQUIFER CHARACTERISTICS
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

Estimation of Aquifer Transmissivities Using Numerical Models,
W83-04157 2F

AQUIFER MANAGEMENT
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

The Contamination and Protection of Aquifers,
W83-04020 5B

AQUIFER PROPERTIES
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

AQUIFER TESTING
Johnson Velocity Meter System Proves its Worth,
W83-04076 8B

ARID LANDS
Planning for Increased Crop Production Under Limited Water Resources in Arid and Semi-Arid Conditions,
W83-03868 3F

Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

ARID-ZONE HYDROLOGY
A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

ARIZONA
Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

Residual-Wax Soil Treatments for Water Harvesting,
W83-04038 3B

Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

Estimation of Aquifer Transmissivities Using Numerical Models,
W83-04157 2F

AROMATIC COMPOUNDS
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

AROMATIC HYDROCARBONS
Polycyclic Aromatic Hydrocarbons-Are They a Problem in Processed Oil Shales,
W83-04148 5B

ASBESTOS
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

ATTITUDES
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

AUSTRALIA
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

Seasonal Variation in the Macroinvertebrate Fauna of Billabongs Along Magela Creek, Northern Territory,
W83-03891 2H

Plankton of the Lower River Murray, South Australia,
W83-03892 5C

Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

AUTOMATION
Discrete-Time, Cutback Furrow Irrigation,
W83-03958 3F

The Problems and Benefits of Small-Scale Hydro (Part 2).
W83-04170 6C

BACTERIA
Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

The Location and Nature of Accumulated Phosphorus in Activated Sludge,
W83-03955 5D

Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

BACTERIAL ANALYSIS
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

BANK STORAGE
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

BARITE
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

BARIUM
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

BARRIERS
Effect of Asphalt Sub-Surface Moisture on Water Characteristics and Productivity of Sand Soil,
W83-03875 3F

BATON ROUGE
Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

BEACHES
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

BELGIUM
The Jet Nozzle--A New Submerged Aerator (Die Strahlduse--Ein Neuer Tauchbelufter).
W83-03926 5D

BENEFITS
An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

BENTHIC FAUNA
Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

BIBLIOGRAPHICS
Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

BIGHTS
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

BIOASSAYS
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

BIODEGRADATION
Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

BIOFILMS
Precipitation of Calcium Phosphate and pH-Effects in Denitrifying Biofilms,
W83-03952 5D

BIOINDICATORS
Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

BIOLOGICAL FILTER
Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

BIOLOGICAL PROPERTIES
A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

BIOLOGICAL TREATMENT
Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

BIOLOGICAL WASTEWATER TREATMENT
Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

Biological Regeneration of Activated Carbon,
W83-04133 5D

Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

BIOMANIPULATION
Enhancement of Water Quality in Nebraska Farm Ponds by Control of Eutrophication Through Biomanipulation,
W83-03995 5G

BIOMASS
Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

BISULFITE
Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

BORDER IRRIGATION
Border Ditch Irrigation in Colorado,
W83-03959 3F

BORON
A Study on the Evaluation of Water Quality With Respect to Boron for Wheat and Barley Growth on Loamy Sand Soil,
W83-03870 5C

Spectrophotometric and Fluorimetric Determination of Boron in Soils, Plants and Water by Extraction with 2-Methylpentane-2,4-Diol in Isobutyl Methyl Ketone,
W83-04129 5A

BRACKISH WATER
Desalting Water in Florida,
W83-04196 3A

BRINES
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

BRITISH COLUMBIA
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

BROMEGRASS
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

BROMIDES
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

CADMIUM
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

CALCIUM
Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

CALIFORNIA
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

Assessment of Acidity of Lakes and Precipitation in the Sierra Nevada,
W83-03911 5B

Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

Clarifying Geothermal Fluids,
W83-04052 5F

CARBONATE DETERGENT
Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

CARCINOGENS
Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

CASPIAN SEA
Optimal Control of the Caspian Sea Level,
W83-03949 4A

CELLULOSE ACETATE MEMBRANES
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

CHANNEL FLOW
Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

CHELATION
Determination of Trace Amounts of Molybdenum in Natural Waters by Solvent Extraction-Atomic-Absorption Spectrometry, After Chelating Ion-Exchange Preconcentration,
W83-04127 5A

CHEMICAL ANALYSIS
A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

A Proposed Routine Method for Determining Polycyclic Aromatic Hydrocarbons (Vorschlag Fur Eine Routinemethode Zur Bestimmung Polycyclischer Aromatischer Kohlenwasserstoffe),
W83-04047 5A

CHEMICAL OXIDATION
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

CHEMICAL OXYGEN DEMAND
Evaluation of Correlations Between Absorbance at 254 NM and Cod of River Waters,
W83-03934 5A

The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

CHEMICAL PROPERTIES
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

CHEMICAL WASTEWATER
Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

CHEMISTRY OF PRECIPITATION
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

CHINA
Agricultural Meteorology in China,
W83-03851 2B

CHLORELLA
Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

CHLORINATED HYDROCARBONS
Analysis of Chemistry Associated With Ozonolysis of Organic Pollutant Molecules in Water,
W83-04141 5A

Formation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

CHLORINATION
Reducing the Formation of Trihalomethanes,
W83-03997 5F

Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

Formation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

CHLORINE
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

Continuous Flow Determination of Free Chlorine in Water,
W83-04192 5A

CHLOROFORM
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

CHLOROPHENOLS
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

CHLOROPHYLL
Evaluation of the Phosphorus-Chlorophyll Relationship for Lakes off the Precambrian Shield in Western Canada,
W83-04107 2H

CHLOROPHYLL A
Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

CHLOROPHYTA
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

CHROMATOGRAPHY
Metal Binding Studies of Organic Materials in Water Systems,
W83-04003 5A

Determination of Deuterium Oxide in Water by Reversed-Phase High-Performance Liquid Chromatography,
W83-04190 5A

CLARIFICATION
Clarifying Geothermal Fluids,
W83-04052 5F

Deep Tank Aeration/Flotation, Clarification Adds a New Treatment Dimension,
W83-04085 5D

Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

CLARIFIERS
Aspects of the Performance of Final Clarifiers in the Activated Sludge Process,
W83-03951 5D

CLASSIFICATION
A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

CLAYS
The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

CLEANING
Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

CLEAR-CUTTING
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

CLOGGING
Estimating the Potential for Ochre Clogging Before Installing Drains,
W83-03975 4A

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

CLOSTRIDIUM PERFRINGENS
Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

COAL GASIFICATION
Coal Conversion Solid Waste Disposal,
W83-03858 5E

COAL LIQUEFACTION
Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms,
W83-03877 5C

COAL MINE WASTES
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

COAL MINING
Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

COATINGS
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

COLIFORMS
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

COLLOIDS
A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

COLORADO
Border Ditch Irrigation in Colorado,
W83-03959 3F

COLUMBIA RIVER
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

COMBINED SEWER OUTFLOWS
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

COMBINED SEWER OVERFLOWS
Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

COMPOSTING
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

COMPUTER MODELS
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

COMPUTER PROGRAMS
Computer Aid for Terrace Location,
W83-03957 4D

CONCRETE DAMS
Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

The Seismic Behaviour of Gravity Dams Founded on Low Shear Strength Soil,
W83-04084 8G

Experience in the Use of Rolled Concrete,
W83-04169 8F

CONCRETE TECHNOLOGY
Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

Experience in the Use of Rolled Concrete,
W83-04169 8F

CONFERENCES
1982 Stockholm Conference on Acidification of the Environment,
W83-04095 5B

The Problems and Benefits of Small-Scale Hydro (Part 2).
W83-04170 6C

CONFINED AQUIFERS
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

CONFINED-WATER WELLS
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

CONNECTICUT
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

CONSERVATION
Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

CONSTRUCTION METHODS
Experience in the Use of Rolled Concrete,
W83-04169 8F

COOLING WATER
Multiport Diffusers for Heat Disposal: A Summary,
W83-03864 8B

Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

COPPER
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

COPPER SULFATE
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

CORN
Movement of Water and Nitrate-Nitrogen in a Typical Silt Loam Soil of Western Kansas,
W83-03908 5G

Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

CORROSION CONTROL
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

COST-BENEFIT ANALYSIS
An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

The Problems and Benefits of Small-Scale Hydro (Part 2).
W83-04170 6C

COST ESTIMATES
Solar Powered Electrodialysis - Part II,
W83-03921 3A

COSTS
Quick Returns Don't Pay in Water and Soil Conservation,
W83-04024 6B

CROP PRODUCTION
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

CROP YIELD
A Study on the Evaluation of Water Quality With Respect to Boron for Wheat and Barley Growth on Loamy Sand Soil,
W83-03870 5C

Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

Effect of Dry-Season Soil Management of Water Conservation for the Succeeding Rice Crop in a Tropical Soil,
W83-04066 3F

Effect of Irrigations Scheduled at Different Stages of Growth on Seed Production of Oat,
W83-04087 3F

Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

The Influence of Water Availability on Winter Wheat Yields,
W83-04102 3F

Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

CROP YIELDS
Planning for Increased Crop Production Under Limited Water Resources in Arid and Semi-Arid Conditions,
W83-03868 3F

CZECHOSLOVAKIA
Evaluation of Correlations Between Absorbance at 254 NM and Cod of River Waters,
W83-03934 5A

Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

DAM CONSTRUCTION
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

Experience in the Use of Rolled Concrete,
W83-04169 8F

DAM DESIGN
Financial Aspects of Dam Safety,
W83-04078 8A

Material for Embankment Dams,
W83-04081 8D

The Use of Geotextiles in French Earth Dams,
W83-04082 8D

Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

Large Capacity Bulb Units in Japan,
W83-04166 8C

DAM FOUNDATIONS
Material for Embankment Dams,
W83-04081 8D

DAM STABILITY
P.I.D. Regulation Revisited,
W83-04080 6B

The Seismic Behaviour of Gravity Dams Founded on Low Shear Strength Soil,
W83-04084 8G

DAMSITES
Large Capacity Bulb Units in Japan,
W83-04166 8C

DATA ACQUISITION
Measurement of Water Flows in Unsaturated Media,
W83-03948 2G

DATA COLLECTION
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

DATA COLLECTIONS
Glaciers as a Water Resource,
W83-04021 2C

DATA STORAGE AND RETRIEVAL
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

DATA TRANSMISSION
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

DEBRIS FLOW
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

DECISION MAKING
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

DEEP PERCOLATION
Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

DEFICIT IRRIGATION
Economic Optimization of Irrigation,
W83-04007 3F

DEGRADATION
Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

DENITRIFICATION
Precipitation of Calcium Phosphate and pH-Effects in Denitrifying Biofilms,
W83-03952 5D

Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

DESALINATION
Biphase Turbine for Reverse Osmosis Desalination,
W83-03910 8C

The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

Desalting Water in Florida,
W83-04196 3A

DESALINATION PLANTS
Solar Powered Electrodialysis - Part II,
W83-03921 3A

DESALINATION PROCESSES
A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

DESIGN
Solar Powered Electrodialysis - Part II,
W83-03921 3A

DESIGN CRITERIA
Energy-Efficient Aeration of Activation Basins (Energiefreundliche Beluftung Von Belebungsbecken),
W83-03925 5D

Aspects of the Performance of Final Clarifiers in the Activated Sludge Process,
W83-03951 5D

Design for a Field Sprinkler Infiltrometer,
W83-04072 3F

Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

Evaluating Low-Volume Irrigation Systems for Emission Uniformity,
W83-04111 3F

Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

Physical Design of Overland Flow Systems,
W83-04180 5E

DESORPTION
Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

DETENTION RESERVOIRS
Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

DETERGENTS
Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

DETERMINISTIC METHODS
Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

DEUTERIUM
Determination of Deuterium Oxide in Water by Reversed-Phase High-Performance Liquid Chromatography,
W83-04190 5A

DEVELOPING COUNTRIES
The Problems and Benefits of Small-Scale Hydro (Part 2).
W83-04170 6C

DEWATERING
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

DIFFUSERS
Multiport Diffusers for Heat Disposal: A Summary,
W83-03864 8B

DIFFUSION COEFFICIENT
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

DISINFECTION
Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

DISPERSION
A Field Study of Solute Dispersion in a Shallow, Unconfined Aquifer,
W83-04030 2F

DISSOLVED ORGANIC CARBON
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

DISSOLVED OXYGEN
Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

DISSOLVED SOLIDS. *TOXOCITY
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

DISTRIBUTION PATTERNS
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

DISTRICT OF COLUMBIA
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

DRAINAGE
Chemical and Morphological Soil Characteristics in a New England Drainage-Toposequence,
W83-04036 2G

Interflow of Water Through a Sloping Soil With Seepage Face,
W83-04040 2G

DRAINAGE EFFECTS
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

DRAINAGE ENGINEERING
Early Developments in Drainage Engineering
W83-04115 4A

DRAINAGE SYSTEMS
Drainage Requirements of Salt Affected Soils,
W83-03886 4A

DRAINS
Estimating the Potential for Ochre Clogging Before Installing Drains,
W83-03975 4A

DRINKING WATER
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

DRINKING WATERS
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

DROUGHT
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

The Influence of Water Availability on Winter Wheat Yields,
W83-04102 3F

DROUGHT HARDENING
Drought Hardening of Crop Plants,
W83-04150 2I

DROUGHT RESISTANCE
Drought Hardening of Crop Plants,
W83-04150 2I

DROUGHTS
Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

DUNES
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

DYNAMICS
Dynamic Estimates of River Pollution Under Conditions of Regulation of the River and Anthropogenic Runoff,
W83-03937 5B

EARTH DAMS
Material for Embankment Dams,
W83-04081 8D

The Use of Geotextiles in French Earth Dams,
W83-04082 8D

EARTHWORKS
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

EASEMENTS
Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

ECOLOGICAL DISTRIBUTION
Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

ECONOMIC ASPECTS
Quick Returns Don't Pay in Water and Soil Conservation,
W83-04024 6B

P.I.D. Regulation Revisited,
W83-04080 6B

Large Capacity Bulb Units in Japan,
W83-04166 8C

The Problems and Benefits of Small-Scale Hydro (Part 2).
W83-04170 6C

EFFLUENT CHARGES
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

ELECTRICAL EQUIPMENT
Large Capacity Bulb Units in Japan,
W83-04166 8C

ELECTROCHEMICAL SENSORS
Analysis of the Plant Soil Continuum Using Electrophytograms, Phase II,
W83-04136 3F

ELECTRODES
Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

ELECTRODIALYSIS
Solar Powered Electrodialysis - Part II,
W83-03921 3A

EMBANKMENTS
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

Material for Embankment Dams,
W83-04081 8D

Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

ENERGY
Energy-Efficient Aeration of Activation Basins (Energiefreundliche Beluftung Von Belebungsbecken),
W83-03925 5D

ENERGY BALANCE
Internal Energy Balance and the Richards Equation,
W83-04027 2G

ENGLAND
The Operation, Maintenance and Renovation of Sewerage Systems and Pumping Stations in a Large Municipality,
W83-03929 5D

Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

ENTROPY
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

ENVIRONMENTAL EFFECTS
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

Environmental Corrective Programs at the La Grande Complex (Les Amenagements Correctifs D'Environnement Au Complexe La Grande),
W83-04060 6G

Polycyclic Aromatic Hydrocarbons-Are They a Problem in Processed Oil Shales,
W83-04148 5B

ENVIRONMENTAL IMPACT
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

ENZYMES
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

EROSION
Quantification of Soil Loss and Sediment Produced From Eroded Land,
W83-04037 2J

EROSION CONTROL
Sediment Pollution Control in North Carolina,
W83-03860 5G

Computer Aid for Terrace Location,
W83-03957 4D

Investigations of Vegetation for Stabilizing Eroding Streambanks,
W83-03960 4D

Runoff and Soil Loss in Trinidad Under Different Crops and Soil Management,
W83-04028 4D

Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

ESTUARIES
The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

EUTHROPHICATION
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

EUTROPHICATION
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

EVAPOTRANSPIRATION
An Observational-Data Based Evapotranspiration Function for General Circulation Models,
W83-04116 2D

Water Conservation With Urban Landscape Plants,
W83-04140 3D

FARM MANAGEMENT
Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

FARM PONDS
Enhancement of Water Quality in Nebraska Farm Ponds by Control of Eutrophication Through Biomanipulation,
W83-03995 5G

FARM WASTES
Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

FARMING
Agricultural Meteorology in China,
W83-03851 2B

Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

FATE OF POLLUTANTS
Dynamic Estimates of River Pollution Under Conditions of Regulation of the River and Anthropogenic Runoff,
W83-03937 5B

Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models,
W83-03978 5B

Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

1982 Stockholm Conference on Acidification of the Environment,
W83-04095 5B

Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

FECAL COLIFORM
Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

FECAL STREPTOCOCCUS
Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

FEDERAL REPUBLIC OF GERMANY
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

FILTER MEDIA
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

FILTERS
The Use of Glass-Fiber Paper in Water analyses. Part 1: Properties, Preparation, Rinsing and Scouring Losses (Verwendung Von Glasfaserpapier in Der Wasser-Analytik. Teil 1: Eigenschaften, Vorbereitung, Abspul- Und Auswaschverluste).
W83-04050 5A

FILTRATION
Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

Low Energy Filtration Using Buoyant Media,
W83-04149 5D

Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

FINANCING
Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

Financial Aspects of Dam Safety,
W83-04078 8A

FISH
Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

FISH MANAGEMENT
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

FISH PARASITES
Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

FISH POPULATIONS
Low pH and the Absence of Fish Species in Naturally Acidic Wisconsin Lakes: Inferences for Cultural Acidification,
W83-04108 5C

FLOOD DISCHARGE
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

FLOOD FORECASTING
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

FLOOD FREQUENCY
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

FLOOD PEAKS
Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

FLOODS
Discussion-Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W83-04019 2B

FLORIDA
Desalting Water in Florida,
W83-04196 3A

FLOTATION
Pressure-Release Flotation. Practical Experience from Sweden (Entspannungsflotation. Praktische Erfahrungen Aus Schweden).
W83-03928 5D

FLOW
Flow Processes in the Fissure Network Model (Stromungsvorgange Im Vermaschten Kluftmodell),
W83-04092 2F

FLOW CHARACTERISTICS
Internal Energy Balance and the Richards Equation,
W83-04027 2G

FLOW DENSITY
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

FLOW DISCHARGE
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

FLOW VELOCITY
Johnson Velocity Meter System Proves its Worth,
W83-04076 8B

FLOW VISCOSITY
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

FLUID MECHANICS
Multiport Diffusers for Heat Disposal: A Summary,
W83-03864 8B

FLUVIAL SEDIMENTS
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

FLY ASH
Coal Conversion Solid Waste Disposal,
W83-03858 5E

Phosphate Extraction Using Fly Ash,
W83-03913 5F

FORECASTING
Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

FOREST LITTER
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

FOREST MANAGEMENT
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

FOREST WATERSHEDS
Characteristics of Sediment and Organic Carbon Export From Pristine Boreal Forest Watersheds,
W83-04109 2E

FRANCE
Current Status of Water Distribution in France. Organizational/Administrative Aspects of the Problem (Situation Actuelle De La Distribution D'Eau en France. Organisation-Aspects Administraties du Probleme).
W83-03964 5F

Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

FURROW IRRIGATION
Discrete-Time, Cutback Furrow Irrigation,
W83-03958 3F

FURROWS
Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

GEOHYDROLOGY
A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

GEOLOGIC FRACTURES
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

Flow Processes in the Fissure Network Model (Stromungsvorgange Im Vermaschten Kluftmodell),
W83-04092 2F

GEOLOGIC MAPPING
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

GEOMORPHOLOGY
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

GEOPHYSICAL SURVEYS
Evaluation of a Ground Transient Electromagnetic Remote Sensing Method for the Deep Detection and Monitoring of Salt Water Interfaces,
W83-03899 7B

GEORGIA
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

GEOTHERMAL RESOURCES
Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

Clarifying Geothermal Fluids,
W83-04052 5F

GEOTHERMAL STUDIES
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

GERMAN DEMOCRATIC REPUBLIC
Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

GLACIAL EVENTS
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

GLACIERS
Glaciers as a Water Resource,
W83-04021 2C

GRAVEL
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

GRAZING
Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

GREAT LAKES
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

GREECE
Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

GROUNDWATER
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

GROUNDWATER AVAILABILITY
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

GROUNDWATER LEVEL
Predicting Depth to the Water Table Based on Species Presence on an Oregon Coast Deflation Plain,
W83-04193 2F

GROUNDWATER MOVEMENT
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

GROUNDWATER POLLUTION
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

GROUNDWATER POTENTIAL
Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

GROUNDWATER PROTECTION
EPA's New Land Disposal Rules-A Closer Look,
W83-04100 5E

GROUNDWATER RECHARGE
Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

GULF OF MAINE
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

HAEMATOCOCCUS
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

HALOGENS
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

HAWAII
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

HEALTH RISKS
Health Risks Associated With Water Recycling,
W83-03971 3C

HEAT EXCHANGERS
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

HEAVY METALS
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

Concentration of Heavy Metals in Seawater and Sediments from the Northern Aegean Sea, Greece,
W83-04056 5B

Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

HUMAN DISEASES
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

HYDRAULIC CONDUCTIVITY
Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

HYDRAULIC EQUIPMENT
Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

HYDRAULIC GATES
Water Control by Automatic Gates,
W83-04079 8C

HYDRAULIC PROPERTIES
The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

HYDRAULIC TURBINES
Characteristics of Generators for Small Capacity Schemes,
W83-04168 8C

HYDROCARBONS
A Proposed Routine Method for Determining Polycyclic Aromatic Hydrocarbons (Vorschlag Fur Eine Routinemethode Zur Bestimmung Polycyclischer Aromatischer Kohlenwasserstoffe),
W83-04047 5A

HYDROELECTRIC PLANTS
P.I.D. Regulation Revisited,
W83-04080 6B

Characteristics of Generators for Small Capacity Schemes,
W83-04168 8C

The Problems and Benefits of Small-Scale Hydro (Part 2).
W83-04170 6C

HYDROELECTRIC POWER
Large Capacity Bulb Units in Japan,
W83-04166 8C

Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

HYDROGEN ION CONCENTRATION
Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

HYDROGEN PEROXIDE
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

HYDROLOGIC BUDGET
Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

HYDROLOGIC MAPS
A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

HYDROLOGIC MODELING
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

HYDROLOGIC MODELS
Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

HYDROTHERMAL STUDIES
Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

HYGROMETER
An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

ICE
Glaciers as a Water Resource,
W83-04021 2C

ICE COVER
Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

IDAHO
Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

ILLINOIS
Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

IMPAIRED WATER USE
Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

IMPERVIOUS MEMBRANES
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

INDIA
Ionic Composition of Ground Waters in Jind District (Haryana) and Their Suitability for Crop Growth,
W83-03866 3C

Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

Planning for Increased Crop Production Under Limited Water Resources in Arid and Semi-Arid Conditions,
W83-03868 3F

Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

Drainage Requirements of Salt Affected Soils,
W83-03886 4A

Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

INDIANA
Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

INDICATORS
Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

INDONESIA
Characteristics of Generators for Small Capacity Schemes,
W83-04168 8C

INDUSTRIAL WASTEWATER
The Jet Nozzle--A New Submerged Aerator (Die Strahlduse--Ein Neuer Tauchbelufter).
W83-03926 5D

Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

INFILTRATION
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

Interflow of Water Through a Sloping Soil With Seepage Face,
W83-04040 2G

Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

A U.S. Test for Insituform; or, How to Rebuild Pipe from Within,
W83-04130 8G

INFRARED IMAGERY
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

INLAND WATERWAYS
Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

INORGANIC CHEMICALS INDUSTRY
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

INSITUFORM
A U.S. Test for Insituform; or, How to Rebuild Pipe from Within,
W83-04130 8G

INSPECTION
The Operation, Maintenance and Renovation of Sewerage Systems and Pumping Stations in a Large Municipality,
W83-03929 5D

INSTITUTIONAL CONSTRAINTS
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

INSTREAM FLOW
An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

INVERTEBRATES
Seasonal Variation in the Macroinvertebrate Fauna of Billabongs Along Magela Creek, Northern Territory,
W83-03891 2H

Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

IODOMETRIC TITRATION
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

ION EXCHANGE
The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

IONS
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

IOWA
Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

IRON
Estimating the Potential for Ochre Clogging Before Installing Drains,
W83-03975 4A

Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

IRON BACTERIA
Estimating the Potential for Ochre Clogging Before Installing Drains,
W83-03975 4A

IRRADIATION
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

IRRIGATION
Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

Planning for Increased Crop Production Under Limited Water Resources in Arid and Semi-Arid Conditions,
W83-03868 3F

Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

Discussion: Optimization of Water Resources for Irrigation in East Jordan, by Janusz R. Rydzewski and Hani A-H. Rashid,
W83-03936 3F

Effect of Irrigations Scheduled at Different Stages of Growth on Seed Production of Oat,
W83-04087 3F

Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

IRRIGATION CANALS
Water Control by Automatic Gates,
W83-04079 8C

IRRIGATION DESIGN
Economic Optimization of Irrigation,
W83-04007 3F

IRRIGATION DITCHES
Border Ditch Irrigation in Colorado,
W83-03959 3F

IRRIGATION EFFECTS
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

IRRIGATION EFFICIENCY
Discrete-Time, Cutback Furrow Irrigation,
W83-03958 3F

Border Ditch Irrigation in Colorado,
W83-03959 3F

Economic Optimization of Irrigation,
W83-04007 3F

Analysis of the Plant Soil Continuum Using Electrophytograms, Phase II,
W83-04136 3F

IRRIGATION PRACTICES
Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

Evaluating Low-Volume Irrigation Systems for Emission Uniformity,
W83-04111 3F

IRRIGATION PROGRAMS
Comments on 'A Trickle Irrigation System for Frequent Application of Nitrogen to Experimental Plots', and Reply to Comments,
W83-04033 3F

Time and Frequency of Irrigation Effects on Sunflower Production and Water Use,
W83-04039 3F

IRRIGATION REQUIREMENTS
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

Economic Optimization of Irrigation,
W83-04007 3F

IRRIGATION SCHEDULING
Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

Economic Optimization of Irrigation,
W83-04007 3F

Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

IRRIGATION WATER
Ionic Composition of Ground Waters in Jind District (Haryana) and Their Suitability for Crop Growth,
W83-03866 3C

A Study on the Evaluation of Water Quality With Respect to Boron for Wheat and Barley Growth on Loamy Sand Soil,
W83-03870 5C

Impact of Saline Water Irrigation on Some Crops and Their Varieties,
W83-03885 3C

Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

ISOHYETS
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

ISOTOPE STUDIES
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

ITALY
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

JAMES BAY TERRITORY
Environmental Corrective Programs at the La Grande Complex (Les Amenagements Correctifs D'Environnement Au Complexe La Grande),
W83-04060 6G

JAPAN
Large Capacity Bulb Units in Japan,
W83-04166 8C

Experience in the Use of Rolled Concrete,
W83-04169 8F

JETS
The Jet Nozzle--A New Submerged Aerator (Die Strahlduse--Ein Neuer Tauchbelufter).
W83-03926 5D

JORDAN
Discussion: Optimization of Water Resources for Irrigation in East Jordan, by Janusz R. Rydzewski and Hani A-H. Rashid,
W83-03936 3F

KANSAS
Movement of Water and Nitrate-Nitrogen in a Typical Silt Loam Soil of Western Kansas,
W83-03908 5G

KANSAS RIVER
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

KAOLINITE
Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

KINETICS
Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

LAGOONS
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

LAKE MICHIGAN
Soluble Reactive Phosphorus Measurements in Lake Water: Evidence for Molybdate-Enhanced Hydrolysis,
W83-03977 5A

LAKE SEDIMENTS
Relationship Between Body-Lead Concentration of Mysis Relicta and Sediment-Lead Concentration in Kootenay Lake, B.C.,
W83-04104 5C

A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

LAKE STAGES
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

LAKES
Assessment of Acidity of Lakes and Precipitation in the Sierra Nevada,
W83-03911 5B

Total Dissolved Solids as a Predictor of Lake Biomass and Productivity,
W83-04106 5C

Evaluation of the Phosphorus-Chlorophyll Relationship for Lakes off the Precambrian Shield in Western Canada,
W83-04107 2H

Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

LAMELLA SETTLERS
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

LAND APPLICATION
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

Role of Mycorrhizae in Land Application of Municipal Wastewaters,
W83-04154 3C

Physical Design of Overland Flow Systems,
W83-04180 5E

LAND DISPOSAL
Coal Conversion Solid Waste Disposal,
W83-03858 5E

Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

LAND USE
Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

LANDFILLS
Coal Conversion Solid Waste Disposal,
W83-03858 5E

Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

LANDSAT DATA
The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

LEACHATE
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

LEACHATES
Coal Conversion Solid Waste Disposal,
W83-03858 5E

Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

LEACHING
Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models,
W83-03978 5B

Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

LEAD
Relationship Between Body-Lead Concentration of Mysis Relicta and Sediment-Lead Concentration in Kootenay Lake, B.C.,
W83-04104 5C

LEAF LITTER
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

LEGIONELLA
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

LEGIONNAIRE'S DISEASE BACTERIA
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

LEGISLATION
Sediment Pollution Control in North Carolina,
W83-03860 5G

LEGUMES
Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

LEVASINT COATING
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

LIGHT INTENSITY
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

LIMITING NUTRIENTS
Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

LITERATURE REVIEW
Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

LOAM
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

LOCAL PRECIPITATION
Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

LOGGING
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

LOUISIANA
Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

LYSIMETERS
Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

MACROPHYTES
Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

MACROPORES
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

MADISON LIMESTONE
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

MAGNESIUM
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

MARGINAL COSTS
Economic Optimization of Irrigation,
W83-04007 3F

MARINE ANIMALS
Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

MARINE ENVIRONMENT
Concentration of Heavy Metals in Seawater and Sediments from the Northern Aegean Sea, Greece,
W83-04056 5B

MARINE SEDIMENTS
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

MARKETING
Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

MARKOV PROCESS
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

MARSHES
Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

MARYLAND
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

MASSACHUSETTS
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

Chemical and Morphological Soil Characteristics in a New England Drainage-Toposequence,
W83-04036 2G

Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

MATERIALS ENGINEERING
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

The Seismic Behaviour of Gravity Dams Founded on Low Shear Strength Soil,
W83-04084 8G

MATHEMATICAL EQUATIONS
Long-Time Evolution of an Unstable Water-Wave Train,
W83-03855 2H

The Mechanism of Raindrop Splash on Soil Surfaces,
W83-04034 2J

MATHEMATICAL MODELS
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

An Infiltration Based Runoff Model for a Standardized 24-Hour Rainfall,
W83-03961 2A

Water Control by Automatic Gates,
W83-04079 8C

Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

MATHEMATICAL STUDIES
Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

MEASURING INSTRUMENTS
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

Measurement of Hydraulic Conductivity of Unsaturated Soils with Thermocouple Psychrometers,
W83-04025 2G

An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

MEMBRANE PROCESSES
Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

MERCURY
Mercury Speciation in Water,
W83-04105 5B

Determination of Mercury in Water by Furnace Atomic Absorption Spectrometry After Reduction and Aeration,
W83-04123 5A

Potentiometric Stripping Analysis for Mercury After Preconcentration in a Potassium Permanganate Trap,
W83-04126 5A

METALLOTHIONEIN
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

METALS
Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

METEOROLOGY
Agricultural Meteorology in China,
W83-03851 2B

METHYL MERCURIC CHLORIDE
Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

MICROCOMPUTER
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

MICROORGANISMS
Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

MINE WASTES
Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

Material for Embankment Dams,
W83-04081 8D

Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

MINERAL WATER
Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

MINERALOGY
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

MINERALS
Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

MISSISSIPPI
Investigations of Vegetation for Stabilizing Eroding Streambanks,
W83-03960 4D

MODEL STUDIES
The Essence of Mathematical Models of Reservoir Storage,
W83-03852 4A

Effective Use of STOM,
W83-03931 5D

On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

An Observational-Data Based Evapotranspiration Function for General Circulation Models,
W83-04116 2D

Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

MOISTURE AVAILABILITY
The Influence of Water Availability on Winter Wheat Yields,
W83-04102 3F

MOLLUSKS
The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

MOLYBDENUM
Determination of Trace Amounts of Molybdenum in Natural Waters by Solvent Extraction-Atomic-Absorption Spectrometry, After Chelating Ion-Exchange Preconcentration,
W83-04127 5A

MOLYBDENUM BLUE METHOD
Soluble Reactive Phosphorus Measurements in Lake Water: Evidence for Molybdate-Enhanced Hydrolysis,
W83-03977 5A

MONITORING
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

MOUNTAIN LAKES
Assessment of Acidity of Lakes and Precipitation in the Sierra Nevada,
W83-03911 5B

MT. ST. HELENS
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

MULCHES
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

MULCHING
Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

MUNICIPAL
Role of Mycorrhizae in Land Application of Municipal Wastewaters,
W83-04154 3C

MUNICIPAL WASTEWATER
Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

MUNICIPAL WATERSHEDS
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

MUTAGENS
Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

MYCORRHIZAE DEVELOPMENT
Role of Mycorrhizae in Land Application of Municipal Wastewaters,
W83-04154 3C

MYTILUS
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

NEBRASKA
Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

Enhancement of Water Quality in Nebraska Farm Ponds by Control of Eutrophication Through Biomanipulation,
W83-03995 5G

A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

Quantification of Soil Loss and Sediment Produced From Eroded Land,
W83-04037 2J

Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

NEVADA
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

Nitrate in Nevada Playas,
W83-03994 5A

Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

Reuse Versus Return Flows: Considerations for Selecting a Water Supply Strategy,
W83-04001 6B

Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

NEW BRUNSWICK
Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

NEW JERSEY
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

NEW YORK
Reducing the Formation of Trihalomethanes,
W83-03997 5F

Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

NEW YORK BIGHT
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

NEW ZEALAND
Quick Returns Don't Pay in Water and Soil Conservation,
W83-04024 6B

NICKEL
Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

NITRATE
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

NITRATE-NITROGEN MOVEMENT
Movement of Water and Nitrate-Nitrogen in a Typical Silt Loam Soil of Western Kansas,
W83-03908 5G

NITRATES
Nitrate in Nevada Playas,
W83-03994 5A

NITRIFICATION
Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

NITROAROMATICS
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

NITROGEN
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

Comments on 'A Trickle Irrigation System for Frequent Application of Nitrogen to Experimental Plots', and Reply to Comments,
W83-04033 3F

Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

NITROGEN COMPOUNDS
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

NITROGEN FIXING BACTERIA
Nitrate in Nevada Playas,
W83-03994 5A

NITROGEN REMOVAL
Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

NONPOINT POLLUTION SOURCES
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

Quantification of Soil Loss and Sediment Produced From Eroded Land,
W83-04037 2J

NORTH CAROLINA
Sediment Pollution Control in North Carolina,
W83-03860 5G

Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

NORTH DAKOTA
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

NOZZLES
The Jet Nozzle--A New Submerged Aerator (Die Strahlduse--Ein Neuer Tauchbelufter).
W83-03926 5D

NUTRIENT REMOVAL
Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

NUTRIENTS
A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

ODOR CONTROL
Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

OIL SHALE
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

OIL WASTES
Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms,
W83-03877 5C

OILY WATER
Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

ONTARIO
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

OPEN CHANNEL FLOW
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

OPTICAL PROPERTIES
Evaluation of Correlations Between Absorbance at 254 NM and Cod of River Waters,
W83-03934 5A

OPTIMIZATION
Economic Optimization of Irrigation,
W83-04007 3F

Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

ORCHARDS
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

OREGON
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

Predicting Depth to the Water Table Based on Species Presence on an Oregon Coast Deflation Plain,
W83-04193 2F

ORGANIC CARBON
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

ORGANIC CHLORINE
Formation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

ORGANIC COMPOUNDS
Extraction of Priority Pollutants From Solids,
W83-03859 5D

Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

ORGANIC MATTER
Characteristics of Sediment and Organic Carbon Export From Pristine Boreal Forest Watersheds,
W83-04109 2E

Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

ORGANIC PHOSPHATE
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

ORGANIC SOLVENTS
Extraction of Priority Pollutants From Solids,
W83-03859 5D

ORGANIC WASTES
Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

ORGANOPHOSPHATE INSECTICIDE
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

ORTHOPHOSPHATES
Phosphate Extraction Using Fly Ash,
W83-03913 5F

OSMOREGULATION
Drought Hardening of Crop Plants,
W83-04150 2I

OVERLAND FLOW
Physical Design of Overland Flow Systems,
W83-04180 5E

OXIDATION DITCHES
Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

OXIDATION PROCESS
Factors Affecting the Catalytic and Photolytic Enhancement of Ozonization in Water Solutions,
W83-03901 5F

OXISOLS
Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

OXYGEN REQUIREMENTS
Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

OXYGEN TRANSFER
Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

OXYGENATION
Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

OZONATION
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

OZONE
Factors Affecting the Catalytic and Photolytic Enhancement of Ozonization in Water Solutions,
W83-03901 5F

PACIFIC NORTHWEST U.S
Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

PARAMETRIC HYDROLOGY
Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

PARAOXON
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

PARATHION
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

PARTICULATES
Use of Particle Size Analysis in Drinking Water Preparation (Zum Einsatz Von Partikelgrossenanalysen In Der Trinkwasseraufbereitung),
W83-04091 5A

PATH OF POLLUTANTS
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

PERFORMANCE EVALUATION
Effective Use of STOM,
W83-03931 5D

The Use of Glass-Fiber Paper in Water analyses. Part 1: Properties, Preparation, Rinsing and Scouring Losses (Verwendung Von Glasfaserpapier in Der Wasser-Analytik. Teil 1: Eigenschaften, Vorbereitung, Abspul- Und Auswaschverluste).
W83-04050 5A

The Use of Geotextiles in French Earth Dams,
W83-04082 8D

PERMEABILITY COEFFICIENT
Measurement of Hydraulic Conductivity of Unsaturated Soils with Thermocouple Psychrometers,
W83-04025 2G

Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

PESTICIDE TOXICITY
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

PESTICIDES
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

PHENOL
Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

PHENOLS
Factors Affecting the Catalytic and Photolytic Enhancement of Ozonization in Water Solutions,
W83-03901 5F

Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

PHILLIPINES
Effect of Dry-Season Soil Management of Water Conservation for the Succeeding Rice Crop in a Tropical Soil,
W83-04066 3F

PHOSPHATES
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

Phosphate Extraction Using Fly Ash,
W83-03913 5F

Biochemical Changes Associated With Luxury Phosphate Uptake in a Modified Phoredox Activated Sludge System,
W83-03953 5D

Soluble Reactive Phosphorus Measurements in Lake Water: Evidence for Molybdate-Enhanced Hydrolysis,
W83-03977 5A

Spectrophotometric Determination of Phosphate in River Waters With Molybdate and Malachite Green,
W83-04128 5A

PHOSPHORUS
Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

The Location and Nature of Accumulated Phosphorus in Activated Sludge,
W83-03955 5D

Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

Evaluation of the Phosphorus-Chlorophyll Relationship for Lakes off the Precambrian Shield in Western Canada,
W83-04107 2H

Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

PHOSPHORUS REMOVAL
Phosphate Extraction Using Fly Ash,
W83-03913 5F

PHOTOGRAPHY
Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

PHOTOIONIZATION
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

PHOTOLYSIS
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

PHOTOOXIDATION
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

PHYSICAL PROPERTIES
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

PHYTOPLANKTON
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

Plankton of the Lower River Murray, South Australia,
W83-03892 5C

Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

PHYTOXICITY
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

PIPES
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

PLANT GROWTH
Analysis of the Plant Soil Continuum Using Electrophytograms, Phase II,
W83-04136 3F

PLANT WATER POTENTIAL
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

PLAYA SEDIMENTS
Nitrate in Nevada Playas,
W83-03994 5A

PLAYAS
Nitrate in Nevada Playas,
W83-03994 5A

PLUMES
Variations of the Fraser River Plume and Their Relationship to Forcing by Tide, Wind and Discharge,
W83-04117 2L

POLARITY
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

POLLUTANT IDENTIFICATION
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

Evaluation of Correlations Between Absorbance at 254 NM and Cod of River Waters,
W83-03934 5A

Metal Binding Studies of Organic Materials in Water Systems,
W83-04003 5A

Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

A Proposed Routine Method for Determining Polycyclic Aromatic Hydrocarbons (Vorschlag Fur Eine Routinemethode Zur Bestimmung Polycyclischer Aromatischer Kohlenwasserstoffe),
W83-04047 5A

An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

Analysis of Chemistry Associated With Ozonolysis of Organic Pollutant Molecules in Water,
W83-04141 5A

Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

Determination of Deuterium Oxide in Water by Reversed-Phase High-Performance Liquid Chromatography,
W83-04190 5A

Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

Continuous Flow Determination of Free Chlorine in Water,
W83-04192 5A

Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

POLYAMIDE MEMBRANES
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

POLYCHLORINATED BIPHENYLS
Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

POLYCYCLIC AROMATIC HYDROCARBONS
Polycyclic Aromatic Hydrocarbons-Are They a Problem in Processed Oil Shales,
W83-04148 5B

POLYMERS
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

PONDS
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

Lining a Pond To Contain Uranium Tailings,
W83-04101 5E

POPULATION DENSITY
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

POPULATION DYNAMICS
Zooplankton Diversity and Biomass in Recently Acidified Lakes,
W83-04103 2H

POTABLE WATER
From Wastewater to Drinking Water,
W83-04099 5D

POTHOLE LAKES
Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

POWERPLANTS
Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

PRECIPITATION
Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

PRECIPITATION INTENSITY
Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

PRECIPITATION RATE
Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

PRECOAT FILTRATION
Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

PREDICTING
Discussion-Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W83-04019 2B

PREDICTION
Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

PRETREATMENT
Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

PRETREATMENT OF WATER
A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

PROBABILISTIC PROCESS
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

PROBABLE MAXIMUM PRECIPITATION
On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

PROCESS CONTROL
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

PRODUCTIVITY
Total Dissolved Solids as a Predictor of Lake Biomass and Productivity,
W83-04106 5C

PROJECT PLANNING
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

PUBLIC HEALTH
Health Risks Associated With Water Recycling,
W83-03971 3C

Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

PUBLIC PARTICIPATION
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

PUBLIC WATERS
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

PUMPING
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

PUMPING TESTS
Johnson Velocity Meter System Proves its Worth,
W83-04076 8B

RADAR
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

RADIOACTIVE WASTES
Adsorption of Radium-226 by Biological Origin Absorbents,
W83-04114 5D

RADIUM
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

Adsorption of Radium-226 by Biological Origin Absorbents,
W83-04114 5D

RADON
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

RAINBOW TROUT
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

RAINFALL DISTRIBUTION
On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

RAINFALL DISTRIBUTUION
Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

RAINFALL INFILTRATION
An Infiltration Based Runoff Model for a Standardized 24-Hour Rainfall,
W83-03961 2A

Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

RAINFALL INTENSITY
The Mechanism of Raindrop Splash on Soil Surfaces,
W83-04034 2J

RAINFALL-RUNOFF RELATIONSHIPS
An Infiltration Based Runoff Model for a Standardized 24-Hour Rainfall,
W83-03961 2A

Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

RAINFALL SIMULATORS
Design for a Field Sprinkler Infiltrometer,
W83-04072 3F

RECREATION
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

RECREATION FACILITIES
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

RECYCLING
Extraction of Priority Pollutants From Solids,
W83-03859 5D

Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

RED ALDER (ALNUS RUBRA)
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

RED RIVER FORMATION
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

REFORESTATION
Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

REGENERATION
Biological Regeneration of Activated Carbon,
W83-04133 5D

REGRESSION ANALYSIS
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

REGULATED FLOW
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

REGULATIONS
Principals of Ecological and Hygienic Regulation of Water Quality,
W83-03950 6E

EPA's New Land Disposal Rules-A Closer Look,
W83-04100 5E

REHABILITATION
The Operation, Maintenance and Renovation of Sewerage Systems and Pumping Stations in a Large Municipality,
W83-03929 5D

REINJECTION WELLS
Clarifying Geothermal Fluids,
W83-04052 5F

REMOTE SENSING
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

Spatial Variability of Soil Hydraulics and Remotely Sensed Soil Parameters,
W83-04062 2G

A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

REPAIR
A U.S. Test for Insituform; or, How to Rebuild Pipe from Within,
W83-04130 8G

RESEARCH PRIORITIES
Water Recycling - Research Needs,
W83-03965 3C

RESERVOIR STORAGE
The Essence of Mathematical Models of Reservoir Storage,
W83-03852 4A

RESERVOIRS
Environmental Corrective Programs at the La Grande Complex (Les Amenagements Correctifs D'Environnement Au Complexe La Grande),
W83-04060 6G

RESIDUE CHLORINE
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

RESOURCES MANAGEMENT
P.I.D. Regulation Revisited,
W83-04080 6B

RESPIRATION
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

RETENTION BASINS
Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

RETURN FLOW
Reuse Versus Return Flows: Considerations for Selecting a Water Supply Strategy,
W83-04001 6B

REVEGETATION
Sediment Pollution Control in North Carolina,
W83-03860 5G

Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

REVERSE OSMOSIS
Biphase Turbine for Reverse Osmosis Desalination,
W83-03910 8C

Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

Desalting Water in Florida,
W83-04196 3A

REVIEWS
Water Recycling - Research Needs,
W83-03965 3C

Water Recycling for Domestic and Agricultural Applications: State of the Art,
W83-03969 3C

RICE
Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

RICHARDS EQUATION
Internal Energy Balance and the Richards Equation,
W83-04027 2G

RIPARIAN RIGHTS
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

RISKS
Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

RIVER BASINS
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

RIVERS
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

ROCK FILL
Material for Embankment Dams,
W83-04081 8D

ROTATING BIOLOGICAL CONTACTORS
Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

ROUGHNESS COEFFICIENT
Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

RUNOFF
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

Runoff and Soil Loss in Trinidad Under Different Crops and Soil Management,
W83-04028 4D

Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

RUNOFF FORECASTING
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

RURAL AREAS
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

SAFETY
Financial Aspects of Dam Safety,
W83-04078 8A

P.I.D. Regulation Revisited,
W83-04080 6B

SALAMANDERS
Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

SALINE SOILS
Drainage Requirements of Salt Affected Soils,
W83-03886 4A

SALINE WATER
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

Ionic Composition of Ground Waters in Jind District (Haryana) and Their Suitability for Crop Growth,
W83-03866 3C

Impact of Saline Water Irrigation on Some Crops and Their Varieties,
W83-03885 3C

A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

SALINE WATER BARRIERS
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

SALINE WATER-FRESHWATER INTERFACES
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

SALINITY
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

SALMONELLA
Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

SALT MARSHES
Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

SALT TOELRANCE
Impact of Saline Water Irrigation on Some Crops and Their Varieties,
W83-03885 3C

SALT WATER INTERFACES
Evaluation of a Ground Transient Electromagnetic Remote Sensing Method for the Deep Detection and Monitoring of Salt Water Interfaces,
W83-03899 7B

SAMPLE PREPARATION
The Use of Glass-Fiber Paper in Water analyses. Part 1: Properties, Preparation, Rinsing and Scouring Losses (Verwendung Von Glasfaserpapier in Der Wasser-Analytik. Teil 1: Eigenschaften, Vorbereitung, Abspul- Und Auswaschverluste).
W83-04050 5A

SAND
Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

SAND-BOX MODEL
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

SASKATCHEWAN
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

SATELLITE TECHNOLOGY
The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

SATURATED FLOW
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

SATURATED SOILS
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

SCOUR
The Use of Glass-Fiber Paper in Water analyses. Part 1: Properties, Preparation, Rinsing and Scouring Losses (Verwendung Von Glasfaserpapier in Der Wasser-Analytik. Teil 1: Eigenschaften, Vorbereitung, Abspul- Und Auswaschverluste).
W83-04050 5A

SEA LEVEL
Optimal Control of the Caspian Sea Level,
W83-03949 4A

SEASONAL VARIATION
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

Seasonal Variation in the Macroinvertebrate Fauna of Billabongs Along Magela Creek, Northern Territory,
W83-03891 2H

Plankton of the Lower River Murray, South Australia,
W83-03892 5C

Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

SEASONAL VARIATIONS
Discussion-Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W83-04019 2B

Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

SEAWATER
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

SECONDARY PRODUCTIVITY
Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

SEDIMENT CONTROL
Sediment Pollution Control in North Carolina,
W83-03860 5G

SEDIMENT SIZE
A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

SEDIMENT TRANSPORT
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

Characteristics of Sediment and Organic Carbon Export From Pristine Boreal Forest Watersheds,
W83-04109 2E

SEDIMENT YIELD
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

SEDIMENTARY ROCKS
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

SEDIMENTATION
Historic Changes in an Urban Watershed Determined by Pollen and Geochemical Analyses of Lake Sediment,
W83-04110 5C

SEDIMENTS
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

SEEPAGE
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

SEISMIC PROPERTIES
The Seismic Behaviour of Gravity Dams Founded on Low Shear Strength Soil,
W83-04084 8G

SELENASTRUM
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

SENSITIVITY ANALYSIS
Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

SEPARATION TECHNIQUES
Extraction of Priority Pollutants From Solids,
W83-03859 5D

Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

SEPTIC TANKS
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

SEPTIC WASTEWATER
Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

SETTLERS
Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

SETTLING TANKS
Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

SETTLING VELOCITY
Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

SEWER SYSTEMS
The Operation, Maintenance and Renovation of Sewerage Systems and Pumping Stations in a Large Municipality,
W83-03929 5D

SEWERS
Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

A U.S. Test for Insituform; or, How to Rebuild Pipe from Within,
W83-04130 8G

SILT
Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

SIMULATION
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

SIMULATION ANALYSIS
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

SLOPES
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

SLUDGE CONDITIONING
Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

SLUDGE DIGESTION
Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

SLUDGE DISPOSAL
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

SLUDGE THICKENING
Pressure-Release Flotation. Practical Experience from Sweden (Entspannungsflotation. Praktische Erfahrungen Aus Schweden).
W83-03928 5D

SMALL WATERSHEDS
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

SNOW
Glaciers as a Water Resource,
W83-04021 2C

SNOWMELT
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

SODIUM CARBONATE
A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

SOIL CHARACTERISTICS
Chemical and Morphological Soil Characteristics in a New England Drainage-Toposequence,
W83-04036 2G

SOIL CONSERVATION
Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

SOIL EROSION
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

SOIL FILTERS
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

SOIL GASES
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

SOIL MOISTURE
Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

SOIL MOISTURE AVAILABILITY
Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

SOIL MOISTURE DEFICIENCY
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

SOIL MOISTURE RETENTION
Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

Effect of Asphalt Sub-Surface Moisture on Water Characteristics and Productivity of Sand Soil,
W83-03875 3F

Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

SOIL MORPHOLOGY
Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

SOIL PROPERTIES
Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

Wetting Moisture Characteristic Curves Derived From Constant-Rate Infiltration into Thin Soil Samples,
W83-04042 2G

A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

SOIL TYPES
Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

SOIL WATER
Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

Internal Energy Balance and the Richards Equation,
W83-04027 2G

Interflow of Water Through a Sloping Soil With Seepage Face,
W83-04040 2G

Wetting Moisture Characteristic Curves Derived From Constant-Rate Infiltration into Thin Soil Samples,
W83-04042 2G

Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

Spatial Variability of Soil Hydraulics and Remotely Sensed Soil Parameters,
W83-04062 2G

An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

SOIL-WATER-PLANT RELATIONSHIPS
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

SOIL WATER POTENTIAL
An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

SOIL WATER STORAGE
Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

SOLAR POWER
Solar Powered Electrodialysis - Part II,
W83-03921 3A

SOLID WASTE DISPOSAL
Coal Conversion Solid Waste Disposal,
W83-03858 5E

Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

SOLUTE TRANSPORT
A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models,
W83-03978 5B

A Field Study of Solute Dispersion in a Shallow, Unconfined Aquifer,
W83-04030 2F

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

SOLUTES
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

SORPTION
Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

SOUTH AFRICA
Water Recycling for Domestic and Agricultural Applications: State of the Art,
W83-03969 3C

SOUTH CAROLINA
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

SPATIAL DISTRIBUTION
Spatial Variability of Soil Hydraulics and Remotely Sensed Soil Parameters,
W83-04062 2G

Variations of the Fraser River Plume and Their Relationship to Forcing by Tide, Wind and Discharge,
W83-04117 2L

SPECIATION
Metal Binding Studies of Organic Materials in Water Systems,
W83-04003 5A

Mercury Speciation in Water,
W83-04105 5B

SPECIES COMPOSITION
Seasonal Variation in the Macroinvertebrate Fauna of Billabongs Along Magela Creek, Northern Territory,
W83-03891 2H

The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

SPECIES DIVERSITY
Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

SPECTROPHOTOMETRY
Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

SPECTROSCOPY
A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

SPIRIT LAKE
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

SPRINKLER IRRIGATION
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

SPRINKLERS
Design for a Field Sprinkler Infiltrometer,
W83-04072 3F

STABILIZATION PONDS
Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

STANDARDS
A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

STATISTICAL ANALYSIS
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

STATISTICAL MODELS
Optimal Control of the Caspian Sea Level,
W83-03949 4A

STEEL
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

STOCHASTIC METHODS
Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

STOCHASTIC PROCESS
Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

STOCHASTIC PROCESSES
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

STORET
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

STORM SEWER RUNOFF
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

STORM SEWERS
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

STORM WATER
Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

STORMS
On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

STREAM BANKS
Investigations of Vegetation for Stabilizing Eroding Streambanks,
W83-03960 4D

STREAMFLOW FORECASTING
Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

STREAMFLOW SYNTHESIS
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

STREET RUNOFF SAMPLES
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

STREPTOCOCCUS
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

SUBLETHAL EFFECTS
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

SUBSURFACE DRAINAGE
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

SUBSURFACE FLOW
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

SULFATE
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

SULFIDES
Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

SULFUR
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

SUNFLOWERS
Time and Frequency of Irrigation Effects on Sunflower Production and Water Use,
W83-04039 3F

SURFACE FLOW
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

SURFACE-GROUNDWATER REACTIONS
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

SURFACE-GROUNDWATER RELATIONS
Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

SURFACE WATER
Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

SURFACTANTS
The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

Single-Drop Tensammetry,
W83-04125 5A

SUSPENDED SEDIMENTS
Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

SUSPENDED SOLIDS
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

Use of Particle Size Analysis in Drinking Water Preparation (Zum Einsatz Von Partikelgrossenanalysen In Der Trinkwasseraufbereitung),
W83-04091 5A

Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

SWEDEN
Pressure-Release Flotation. Practical Experience from Sweden (Entspannungsflotation. Praktische Erfahrungen Aus Schweden).
W83-03928 5D

TAX LAWS
Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

TAXES
Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

TEMPERATURE EFFECTS
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

TEMPORAL DISTRIBUTION
Variations of the Fraser River Plume and Their Relationship to Forcing by Tide, Wind and Discharge,
W83-04117 2L

TENNESSEE
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

TERRACING
Computer Aid for Terrace Location,
W83-03957 4D

TERTIARY WASTEWATER TREATMENT
Pressure-Release Flotation. Practical Experience from Sweden (Entspannungsflotation. Praktische Erfahrungen Aus Schweden).
W83-03928 5D

TEXAS
Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

Time and Frequency of Irrigation Effects on Sunflower Production and Water Use,
W83-04039 3F

Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

Water Conservation With Urban Landscape Plants,
W83-04140 3D

Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

THAILAND
Characteristics of Generators for Small Capacity Schemes,
W83-04168 8C

THE NETHERLANDS
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

THERMAL SLUDGE
Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

THERMODYNAMICS
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

THIN LAYER CHROMATOGRAPHY
A Proposed Routine Method for Determining Polycyclic Aromatic Hydrocarbons (Vorschlag Fur Eine Routinemethode Zur Bestimmung Polycyclischer Aromatischer Kohlenwasserstoffe),
W83-04047 5A

THIOBACILLUS
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

THORIUM
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

TIDAL POWERPLANTS
Large Capacity Bulb Units in Japan,
W83-04166 8C

TILE DRAINAGE
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

Early Developments in Drainage Engineering,
W83-04135 4A

TILE DRAINS
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

TILLAGE SYSTEMS
Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

TOBACCO
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

TOXICITY
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

A Threshold Concept of Environmental Pollutants,
W83-04057 5C

TRACE ELEMENTS
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

TRACE METALS
Metal Binding Studies of Organic Materials in Water Systems,
W83-04003 5A

Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

The Determination of Trace Elements in Natural Waters Using the Stabilized Temperature Platform Furnace,
W83-04118 5A

Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

TRANSITION ZONES
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

TRANSMISSIVITY
Estimation of Aquifer Transmissivities Using Numerical Models,
W83-04157 2F

TREATED WATER
Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

TREMATODES
Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

TRENCHES
Early Developments in Drainage Engineering,
W83-04135 4A

TRICKLE IRRIGATION
Comments on 'A Trickle Irrigation System for Frequent Application of Nitrogen to Experimental Plots', and Reply to Comments,
W83-04033 3F

TRIHALOMETHANES
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

Reducing the Formation of Trihalomethanes,
W83-03997 5F

Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

TRINIDAD
Runoff and Soil Loss in Trinidad Under Different Crops and Soil Management,
W83-04028 4D

TRINITROTOLUENE
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

TURBIDITY
Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

TURBINES
Biphase Turbine for Reverse Osmosis Desalination,
W83-03910 8C

Large Capacity Bulb Units in Japan,
W83-04166 8C

ULTRAFILTRATION
Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

ULTRAFINE ION EXCHANGE
Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

ULTRAVIOLET RADIATION
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

UNCONFINED AQUIFERS
A Field Study of Solute Dispersion in a Shallow, Unconfined Aquifer,
W83-04030 2F

UNITED KINGDOM
Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

UNSATURATED FLOW
Measurement of Water Flows in Unsaturated Media,
W83-03948 2G

A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

Internal Energy Balance and the Richards Equation,
W83-04027 2G

UNSTABLE CHANNELS
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

URANIUM
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

URBAN HYDROLOGY
Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

URBAN LANDSCAPES
Water Conservation With Urban Landscape Plants,
W83-04140 3D

URBAN RUNOFF
Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

USSR
Dynamic Estimates of River Pollution Under Conditions of Regulation of the River and Anthropogenic Runoff,
W83-03937 5B

Optimal Control of the Caspian Sea Level,
W83-03949 4A

UTAH
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

VEGETATION EFFECTS
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

VEGETATION ESTABLISHMENT
Investigations of Vegetation for Stabilizing Eroding Streambanks,
W83-03960 4D

VIRGINIA
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

VIRUSES
Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

VITOX SYSTEM
Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

VOLATILITY
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

VOLUMETRIC ANALYSIS
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

WASHINGTON
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

WASTE DISPOSAL
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

EPA's New Land Disposal Rules-A Closer Look,
W83-04100 5E

Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

WASTE RECOVERY
Extraction of Priority Pollutants From Solids,
W83-03859 5D

Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

WASTE STORAGE
Lining a Pond To Contain Uranium Tailings,
W83-04101 5E

WASTE WATER TREATMENT
Purification of Faecal Waters Combined with Algal Protein Production (Ochistvane Na Vodi S Fekalen Kharakter, Suchetano S Poluchavane Na Vodoraslov Protein),
W83-04074 5D

Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

WASTEWATER
Role of Mycorrhizae in Land Application of Municipal Wastewaters,
W83-04154 3C

WASTEWATER DISPOSAL
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

Physical Design of Overland Flow Systems,
W83-04180 5E

WASTEWATER IRRIGATION
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

WASTEWATER MANAGEMENT
Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

WASTEWATER TREATMENT
Extraction of Priority Pollutants From Solids,
W83-03859 5D

Integrated Control of Combined Sewer Regulators,
W83-03862 5G

Factors Affecting the Catalytic and Photolytic Enhancement of Ozonization in Water Solutions,
W83-03901 5F

Energy-Efficient Aeration of Activation Basins (Energiefreundliche Beluftung Von Belebungsbecken),
W83-03925 5D

The Jet Nozzle--A New Submerged Aerator (Die Strahlduse--Ein Neuer Tauchbelufter).
W83-03926 5D

Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

Pressure-Release Flotation. Practical Experience from Sweden (Entspannungsflotation. Praktische Erfahrungen Aus Schweden).
W83-03928 5D

Effective Use of STOM,
W83-03931 5D

Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

Aspects of the Performance of Final Clarifiers in the Activated Sludge Process,
W83-03951 5D

Precipitation of Calcium Phosphate and pH-Effects in Denitrifying Biofilms,
W83-03952 5D

Biochemical Changes Associated With Luxury Phosphate Uptake in a Modified Phoredox Activated Sludge System,
W83-03953 5D

Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

The Location and Nature of Accumulated Phosphorus in Activated Sludge,
W83-03955 5D

Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

Some Aspects of the Present Status of Algae Cultivation and Their Application (Nekotorye Aspekty Sovremennogo Sostoyaniya Kul'Tivirovaniya Vodoroslei I Ikh Primenenie),
W83-04073 5D

Deep Tank Aeration/Flotation, Clarification Adds a New Treatment Dimension,
W83-04085 5D

From Wastewater to Drinking Water,
W83-04099 5D

An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

Low Energy Filtration Using Buoyant Media,
W83-04149 5D

Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

WASTEWATER TREATMENT FACILITIES

Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

WATER

Mercury Speciation in Water,
W83-04105 5B

WATER ALLOCATION

Discussion: Optimization of Water Resources for Irrigation in East Jordan, by Janusz R. Rydzewski and Hani A-H. Rashid,
W83-03936 3F

WATER ANALYSIS

Soluble Reactive Phosphorus Measurements in Lake Water: Evidence for Molybdate-Enhanced Hydrolysis,
W83-03977 5A

Water Quality Monitoring - Rivers and Streams, 1981.
W83-03993 7C

Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

A Proposed Routine Method for Determining Polycyclic Aromatic Hydrocarbons (Vorschlag Fur Eine Routinemethode Zur Bestimmung Polycyclischer Aromatischer Kohlenwasserstoffe),
W83-04047 5A

The Use of Glass-Fiber Paper in Water analyses. Part 1: Properties, Preparation, Rinsing and Scouring Losses (Verwendung Von Glasfaserpapier in Der Wasser-Analytik. Teil 1: Eigenschaften, Vorbereitung, Abspul- Und Auswaschverluste).
W83-04050 5A

Use of Particle Size Analysis in Drinking Water Preparation (Zum Einsatz Von Partikelgrossenanalysen In Der Trinkwasseraufbereitung),
W83-04091 5A

The Determination of Trace Elements in Natural Waters Using the Stabilized Temperature Platform Furnace,
W83-04118 5A

A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

Determination of Mercury in Water by Furnace Atomic Absorption Spectrometry After Reduction and Aeration,
W83-04123 5A

Single-Drop Tensammetry,
W83-04125 5A

Potentiometric Stripping Analysis for Mercury After Preconcentration in a Potassium Permanganate Trap,
W83-04126 5A

Determination of Trace Amounts of Molybdenum in Natural Waters by Solvent Extraction-Atomic-Absorption Spectrometry, After Chelating Ion-Exchange Preconcentration,
W83-04127 5A

Spectrophotometric Determination of Phosphate in River Waters With Molybdate and Malachite Green,
W83-04128 5A

Spectrophotometric and Fluorimetric Determination of Boron in Soils, Plants and Water by Extraction with 2-Methylpentane-2,4-Diol in Isobutyl Methyl Ketone,
W83-04129 5A

Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

Continuous Flow Determination of Free Chlorine in Water,
W83-04192 5A

WATER CIRCULATION

The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

WATER CONSERVATION

Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

Time and Frequency of Irrigation Effects on Sunflower Production and Water Use,
W83-04039 3F

Effect of Dry-Season Soil Management of Water Conservation for the Succeeding Rice Crop in a Tropical Soil,
W83-04066 3F

Water Conservation With Urban Landscape Plants,
W83-04140 3D

Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

WATER DEMAND

Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

WATER DISTRIBUTION

Current Status of Water Distribution in France. Organizational/Administrative Aspects of the Problem (Situation Actuelle De La Distribution D'Eau en France. Organisation-Aspects Administraties du Probleme).
W83-03964 5F

WATER HARVESTING

Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

Residual-Wax Soil Treatments for Water Harvesting,
W83-04038 3B

WATER INFILTRATION

Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

WATER LAW

Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

WATER LEVEL FLUCTUATIONS

Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

WATER MANAGEMENT

Reuse Versus Return Flows: Considerations for Selecting a Water Supply Strategy,
W83-04001 6B

WATER MEASUREMENT

Water Quality Monitoring - Rivers and Streams, 1981.
W83-03993 7C

WATER POLLUTION

Water Quality Monitoring - Rivers and Streams, 1981.
W83-03993 7C

WATER POLLUTION CONTROL
Water Quality Monitoring - Rivers and Streams, 1981.
W83-03993 7C

The Regional Seas Program: What Fate for UNEP's Crown Jewels.,
W83-04131 5B

WATER POLLUTION EFFECTS
Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms,
W83-03877 5C

Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

Water Quality Monitoring - Rivers and Streams, 1981.
W83-03993 7C

The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

WATER POLLUTION EFFECTS. *AIR POLLUTION
1982 Stockholm Conference on Acidification of the Environment,
W83-04095 5B

WATER POLLUTION PREVENTION
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

WATER POLLUTION SOURCES
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

The Contamination and Protection of Aquifers,
W83-04020 5B

A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

Groundwater Protection - Sufficient Against Threats to Public Water Supply Due to Groundwater Pollution. (Grundwasser-Schutz - Austreichend Angesichts Der Bedrohung Der Offentlichen Wasserversorgung Durch Grundwasserverunreinigungen.),
W83-04093 5B

Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

WATER QUALITY
Ionic Composition of Ground Waters in Jind District (Haryana) and Their Suitability for Crop Growth,
W83-03866 3C

Principals of Ecological and Hygienic Regulation of Water Quality,
W83-03950 6E

Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

WATER QUALITY CONTROL
Current Status of Water Distribution in France. Organizational/Administrative Aspects of the Problem (Situation Actuelle De La Distribution D'Eau en France. Organisation-Aspects Administraties du Probleme).
W83-03964 5F

Enhancement of Water Quality in Nebraska Farm Ponds by Control of Eutrophication Through Biomanipulation,
W83-03995 5G

A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

WATER QUALITY STANDARDS
The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

WATER REPELLENT SOILS
Residual-Wax Soil Treatments for Water Harvesting,
W83-04038 3B

WATER REUSE
Water Recycling - Research Needs,
W83-03965 3C

Water Recycling for Domestic and Agricultural Applications: State of the Art,
W83-03969 3C

Health Risks Associated With Water Recycling,
W83-03971 3C

Reuse Versus Return Flows: Considerations for Selecting a Water Supply Strategy,
W83-04001 6B

From Wastewater to Drinking Water,
W83-04099 5D

Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

WATER SAMPLING
Water Quality Monitoring - Rivers and Streams, 1981.
W83-03993 7C

WATER STATUS MEASUREMENT
Analysis of the Plant Soil Continuum Using Electrophytograms, Phase II,
W83-04136 3F

WATER STORAGE
Drainage Requirements of Salt Affected Soils,
W83-03886 4A

WATER STRESS
Drought Hardening of Crop Plants,
W83-04150 2I

WATER SUPPLY
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

Current Status of Water Distribution in France. Organizational/Administrative Aspects of the Problem (Situation Actuelle De La Distribution D'Eau en France. Organisation-Aspects Administraties du Probleme).
W83-03964 5F

Groundwater Protection - Sufficient Against Threats to Public Water Supply Due to Groundwater Pollution. (Grundwasser-Schutz - Austreichend Angesichts Der Bedrohung Der Offentlichen Wasserversorgung Durch Grundwasserverunreinigungen.),
W83-04093 5B

WATER SURFACE PROFILES
Long-Time Evolution of an Unstable Water-Wave Train,
W83-03855 2H

WATER TABLE
Predicting Depth to the Water Table Based on Species Presence on an Oregon Coast Deflation Plain,
W83-04193 2F

WATER TABLE FLUCTUATIONS
Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

WATER TABLE PROFILES
Predicting Depth to the Water Table Based on Species Presence on an Oregon Coast Deflation Plain,
W83-04193 2F

WATER TANKS
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

WATER TREATMENT
Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

Pressure-Release Flotation. Practical Experience from Sweden (Entspannungsflotation. Praktische Erfahrungen Aus Schweden).
W83-03928 5D

Reducing the Formation of Trihalomethanes,
W83-03997 5F

Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

Low Energy Filtration Using Buoyant Media,
W83-04149 5D

Formation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

WATER TREATMENT (PLANTS)
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

WATER USE
Water Conservation With Urban Landscape Plants,
W83-04140 3D

WATER USE EFFICIENCY
Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

Effect of Asphalt Sub-Surface Moisture on Water Characteristics and Productivity of Sand Soil,
W83-03875 3F

Movement of Water and Nitrate-Nitrogen in a Typical Silt Loam Soil of Western Kansas,
W83-03908 5G

Utiiization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

WATERSHED MANAGEMENT
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

WATERSHEDS
Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

Historic Changes in an Urban Watershed Determined by Pollen and Geochemical Analyses of Lake Sediment,
W83-04110 5C

WAVE TRAINS
Long-Time Evolution of an Unstable Water-Wave Train,
W83-03855 2H

WEIRS
Water Control by Automatic Gates,
W83-04079 8C

WELL HYDRAULICS
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

WELL YIELD
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

WEST VIRGINIA
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

WHEAT
Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

WILDLIFE
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

X-RAY FLUORESCENCE
Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

X-RAY FLUROESCENCE
Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

ZOOPLANKTON
Plankton of the Lower River Murray, South Australia,
W83-03892 5C

Zooplankton Diversity and Biomass in Recently Acidified Lakes,
W83-04103 2H

AUTHOR INDEX

ABROL, I. P.
Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

ACHARYA, C. L.
Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

ADAMS, P. W.
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

ADAMS, V. D.
Polycyclic Aromatic Hydrocarbons-Are They a Problem in Processed Oil Shales,
W83-04148 5B

ADRIAN, D. D.
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

AGGARWAL, R. K.
Effect of Asphalt Sub-Surface Moisture on Water Characteristics and Productivity of Sand Soil,
W83-03875 3F

AGGAZZOTTI, G.
Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

AHUJA, L. R.
Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

Interflow of Water Through a Sloping Soil With Seepage Face,
W83-04040 2G

AL-DURRAH, M. M.
The Mechanism of Raindrop Splash on Soil Surfaces,
W83-04034 2J

AL-HAJJAR, B.
Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

ALBERT, D. B.
Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

AMIRFATHI, P.
An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

ANDRUZZI, R.
Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

AOKI, T.
Continuous Flow Determination of Free Chlorine in Water,
W83-04192 5A

ARAL, M. M.
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

ARBER, R. P.
From Wastewater to Drinking Water,
W83-04099 5D

ARCHER, D. R.
Discussion-Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W83-04019 2B

AREN, K.
Potentiometric Stripping Analysis for Mercury After Preconcentration in a Potassium Permanganate Trap,
W83-04126 5A

ARNOLD, K. -H.
Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

ARVIN, E.
Precipitation of Calcium Phosphate and pH-Effects in Denitrifying Biofilms,
W83-03952 5D

ASRAR, G.
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

ATEV, A. P.
Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

ATSUYA, I.
Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

AZIZ EL SAYED, J. A.
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

AZNAREZ, J.
Spectrophotometric and Fluorimetric Determination of Boron in Soils, Plants and Water by Extraction with 2-Methylpentane-2,4-Diol in Isobutyl Methyl Ketone,
W83-04129 5A

BAES, C. F. III
A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models,
W83-03978 5B

BAILEY, W. F.
Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

BAKER, M. D.
Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

BALDWIN, R. D.
Lining a Pond To Contain Uranium Tailings,
W83-04101 5E

BALLINGER, D.
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

BARAZE, A.
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

BARFIELD, B. J.
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

BARTAK, D. E.
Metal Binding Studies of Organic Materials in Water Systems,
W83-04003 5A

BEG, S. A.
Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

BEIM, A. M.
Principals of Ecological and Hygienic Regulation of Water Quality,
W83-03950 6E

BEKOV, G. I.
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

BELL, A.
Quick Returns Don't Pay in Water and Soil Conservation,
W83-04024 6B

BELL, C. R.
Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

BELMANS, C. F. M.
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

BENDER, R. L.
Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

BENDERLIEV, K. M.
Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

Purification of Faecal Waters Combined with Algal Protein Production (Ochistvane Na Vodi S Fekalen Kharakter, Suchetano S Poluchavane Na Vodoraslov Protein),
W83-04074 5D

BENHAM, E. C.
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

BERAR, U.
Water Control by Automatic Gates,
W83-04079 8C

BERG, G. E.
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

BEVERIDGE, A.
The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

BEYER, W. N.
Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

BHARGAVA, T. N.
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

BHATI, O. P.
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

BHATIA, K. S.
Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

BHUSHAN, L. S.
Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

BIERE, A. W.
Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

BINGHAM, R. H.
Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

BISHOP, A. B.
An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

BISOGNI, C. A.
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

BLACHFORD, A. J.
Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

BLOCK, R. M.
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

BODINE, S. M.
Chemical and Morphological Soil Characteristics in a New England Drainage-Toposequence,
W83-04036 2G

BOEGLY, W. J. JR.
Coal Conversion Solid Waste Disposal,
W83-03858 5E

BOLTON, E. E.
Biological Regeneration of Activated Carbon,
W83-04133 5D

BONILLA, A.
Spectrophotometric and Fluorimetric Determination of Boron in Soils, Plants and Water by Extraction with 2-Methylpentane-2,4-Diol in Isobutyl Methyl Ketone,
W83-04129 5A

BONOMO, J. D.
Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

BOOKTER, T. J.
Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

BOSSHART, R. P.
Comments on 'A Trickle Irrigation System for Frequent Application of Nitrogen to Experimental Plots', and Reply to Comments,
W83-04033 3F

BOUMA, J.
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

BOURBIGOT, M. M.
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

BOWIE, A. J.
Investigations of Vegetation for Stabilizing Eroding Streambanks,
W83-03960 4D

BRADFORD, J. M.
The Mechanism of Raindrop Splash on Soil Surfaces,
W83-04034 2J

BRAHMA, S. K.
A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

BRAKENSIEK, D. L.
An Infiltration Based Runoff Model for a Standardized 24-Hour Rainfall,
W83-03961 2A

BRAUN, H. E.
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

BRAUN, P.
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

BREZONIK, P.
Low Energy Filtration Using Buoyant Media,
W83-04149 5D

BRITT, H. K.
Sediment Pollution Control in North Carolina,
W83-03860 5G

BRITZ, D.
Single-Drop Tensammetry,
W83-04125 5A

BROADBENT, F. E.
Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

BROWN, D. L.
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

BROWN, G.
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

BRUCE, L. P.
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

BRUCE, R. R.
Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

BRUNET, R.
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

BRUNINI, O.
An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

BRYCE, R. W.
Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

BUCHAN, L.
The Location and Nature of Accumulated Phosphorus in Activated Sludge,
W83-03955 5D

BUCHHEIM, M. A.
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

BUDAGOVSKII, A. I.
Measurement of Water Flows in Unsaturated Media,
W83-03948 2G

BUNN, R. A.
Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

BURINI, G.
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

BURRELL, B.
Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

BURTON, D. T.
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

CALCROFT, M.
Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

CAMERON, D. R.
Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

CAMPANA, M. E.
Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

CARAVAJAL, G. S.
Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

CARLSON, C. -G. H.
Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

CARMICHAEL, W. F.
Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

CARRINGTON, E. G.
Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

CARTIER, P. G.
Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

CARTWRIGHT, K.
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

CHAMBERS, R. H.
Effective Use of STOM,
W83-03931 5D

CHAMP, M. A.
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

CHANEY, R. L.
Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

CHATTERJI, P. C.
A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

CHEGWIDDEN, A.
Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

CHENG, T. C.
Mercury Speciation in Water,
W83-04105 5B

CHERKESOV, N. V.
Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

CHERY, D. C.
Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

CHESHIRE, H. M.
The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

CHESTERS, G.
Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

CHIESA, S.
Low Energy Filtration Using Buoyant Media,
W83-04149 5D

CHONG, S. K.
Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

CHOUDHARI, J. S.
Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

CHU, S. -Y.
Internal Energy Balance and the Richards Equation,
W83-04027 2G

CHUNG, S. -O.
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

CLARK, M. J. R.
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

CLINE, D. M.
An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

CLYMA, W.
Border Ditch Irrigation in Colorado,
W83-03959 3F

COLLINS, R. A.
Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

COLLINS, W. J.
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

CONFER, J. L.
Zooplankton Diversity and Biomass in Recently Acidified Lakes,
W83-04103 2H

CONN, G.
Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

CONTI, R.
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

COOPER, J. J.
Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

COOTE, D. R.
Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

CORNEL, P.
Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

COWART, J. B.
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

COX, W. E.
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

CRONIN, L. E.
Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

CROOK, B. V.
Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

CROWTHER, H. G.
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

CUDBY, D. B.
Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

CULLEY, J. L. B.
Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

CUNNINGHAM, A. B.
Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

CURTIS, A. A.
Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

CURTIS, R. E. JR.
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

CUSHING, E. M.
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

D'AURIA, J. M.
Historic Changes in an Urban Watershed Determined by Pollen and Geochemical Analyses of Lake Sediment,
W83-04110 5C

DAGUE, R. R.
Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

DAHLSTROM, D. A.
Clarifying Geothermal Fluids,
W83-04052 5F

DALENBERG, J. W.
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

DAMIANI, P.
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

DANIEL, D. E.
Measurement of Hydraulic Conductivity of Unsaturated Soils with Thermocouple Psychrometers,
W83-04025 2G

DANIELSON, R. E.
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

DAULAY, H. S.
Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

DAVAR, K. S.
Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

DAVENPORT, D. C.
Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

DAVIS, C.
Aspects of the Performance of Final Clarifiers in the Activated Sludge Process,
W83-03951 5D

DAVIS, E. C.
Coal Conversion Solid Waste Disposal,
W83-03858 5E

DAVIS, J. M.
Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

DE DATTA, S. K.
Effect of Dry-Season Soil Management of Water Conservation for the Succeeding Rice Crop in a Tropical Soil,
W83-04066 3F

DE JONG, E.
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

DE SOUSA, F.
Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

DEKKER, L. W.
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

DELEON, A. A.
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

DEROOS, H. P.
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

DESSY, R. E.
Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

DEWALT, B. R.
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

DEY, R.
Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

DHAR, O. N.
On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

DICKINSON, W. T.
Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

DILOV, C. V.
Intensive Cultivation of Microalgae in Waste Water from a Pig-Breeding Farm,
W83-04075 5D

Purification of Faecal Waters Combined with Algal Protein Production (Ochistvane Na Vodi S Fekalen Kharakter, Suchetano S Poluchavane Na Vodoraslov Protein),
W83-04074 5D

Some Aspects of the Present Status of Algae Cultivation and Their Application (Nekotorye Aspekty Sovremennogo Sostoyaniya Kul'Tivirovaniya Vodoroslei I Ikh Primenenie),
W83-04073 5D

DIPPEL, G.
Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

DISSANAYAKE, M. G.
Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

DIYAMANDOGLU, V.
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

DOBBERKAU, H. -J.
A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

DOE, P. W.
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

DONER, H. E.
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

DONOVAN, T.
Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

DORE, M.
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

DOWNING, A. L.
Water Recycling - Research Needs,
W83-03965 3C

DYKES, G. M.
Desalting Water in Florida,
W83-04196 3A

EDDE, H.
Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

EDEN, G. E.
Water Recycling - Research Needs,
W83-03965 3C

EDENBORN, H. M.
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

EDER, B. K.
Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

EISENREICH, S. J.
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

EL'PINER, L. I.
Principals of Ecological and Hygienic Regulation of Water Quality,
W83-03950 6E

ELLIOTT, N. G.
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

ELNER, J. K.
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

EMERY, W. J.
Variations of the Fraser River Plume and Their Relationship to Forcing by Tide, Wind and Discharge,
W83-04117 2L

EMMETT, R. C. JR.
Clarifying Geothermal Fluids,
W83-04052 5F

ENGBERG, R. A.
A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

ENGLISH, M. J.
Economic Optimization of Irrigation,
W83-04007 3F

ERMAN, D. C.
Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

EVANS, B. W.
Biochemical Changes Associated With Luxury Phosphate Uptake in a Modified Phoredox Activated Sludge System,
W83-03953 5D

EVANS, R. D.
Relationship Between Body-Lead Concentration of Mysis Relicta and Sediment-Lead Concentration in Kootenay Lake, B.C.,
W83-04104 5C

FAAS, L.
An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

FAHLBUSCH, F.
Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

FAIRBANKS, R. G.
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

FAKHRAEI, H.
Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

FAYER, M. J.
Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

FAYOUX, D.
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

FENNESSY, M. J.
An Observational-Data Based Evapotranspiration Function for General Circulation Models,
W83-04116 2D

FETTIG, J.
Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

FINE, L. O.
Phosphate Extraction Using Fly Ash,
W83-03913 5F

FINK, D. H.
Residual-Wax Soil Treatments for Water Harvesting,
W83-04038 3B

FISHER, J. B.
Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

FISHER, S. G.
Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

FITZNER, R. E.
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

FLEISCHACKER, S. J.
Formation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

FORD, H. W.
Estimating the Potential for Ochre Clogging Before Installing Drains,
W83-03975 4A

FOSS, J. E.
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

FOSTER, G. R.
Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

FOX, C. A.
Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

FRANCIS, C. W.
Coal Conversion Solid Waste Disposal,
W83-03858 5E

FRANCIS, D. D.
Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

FRANK, R.
Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

FRANKLIN, M.
Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

FRIBERG, S.
A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

FRITH, J. G.
Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

FUJIOKA, R. S.
Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

FULLERTON, H. H.
Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

FYTIANOS, K.
Concentration of Heavy Metals in Seawater and Sediments from the Northern Aegean Sea, Greece,
W83-04056 5B

Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

GANAPATI, P. N.
Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

GANF, G.
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

GARDNER, E. H.
Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

GAY, M. C.
Evaluation of a Ground Transient Electromagnetic Remote Sensing Method for the Deep Detection and Monitoring of Salt Water Interfaces,
W83-03899 7B

GEE, H. K.
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

GENSLER, W.
Analysis of the Plant Soil Continuum Using Electrophytograms, Phase II,
W83-04136 3F

GERBA, C. P.
Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

GERRITSE, R. G.
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

GHANE, H.
Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

GHOSH, P. K.
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

GIDDINGS, J. M.
Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms,
W83-03877 5C

GILKESON, R. H.
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

GIORDANO, C.
Water Conservation With Urban Landscape Plants,
W83-04140 3D

GLATER, J.
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

GLEBOV, V. D.
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

GNAUCK, A. H.
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

GODFREY, P. J.
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

GOFORTH, D.
Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

GOPAL, R.
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

GORDIN, I. V.
Dynamic Estimates of River Pollution Under Conditions of Regulation of the River and Anthropogenic Runoff,
W83-03937 5B

GOULTER, I. C.
Discussion: Optimization of Water Resources for Irrigation in East Jordan, by Janusz R. Rydzewski and Hani A-H. Rashid,
W83-03936 3F

GRACIA, I.
Determination of Trace Amounts of Molybdenum in Natural Waters by Solvent Extraction-Atomic-Absorption Spectrometry, After Chelating Ion-Exchange Preconcentration,
W83-04127 5A

GRADY, C. P. L. JR.
Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

GRAHAM, L.
Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

GRANELI, A.
Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

GRANT, S. A.
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

GREEN, R. E.
Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head

From Measurements of Soil Water Redistribution,
W83-04041 2G

GREGOR, K. -H.
Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

GREGORY, J. M.
Computer Aid for Terrace Location,
W83-03957 4D

GRIFFITHS, J. A.
Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

GRIMM, N. B.
Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

GRIMMEISEN, W.
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

GRIMMEL, W.
Energy-Efficient Aeration of Activation Basins (Energiefreundliche Beluftung Von Belebungsbecken),
W83-03925 5D

GROENEWOLD, G. H.
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

GUMBS, F. A.
Runoff and Soil Loss in Trinidad Under Different Crops and Soil Management,
W83-04028 4D

GUPTA, J. P.
Effect of Asphalt Sub-Surface Moisture on Water Characteristics and Productivity of Sand Soil,
W83-03875 3F

Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

GUSEV, E. M.
Measurement of Water Flows in Unsaturated Media,
W83-03948 2G

HACKES, B. L.
Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

HAGAN, R. M.
Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

HAGEMAN, L.
Determination of Mercury in Water by Furnace Atomic Absorption Spectrometry After Reduction and Aeration,
W83-04123 5A

HAM, R. K.
Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

HAMPTON, B. B.
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

HANDLEY, D.
Evaluating Low-Volume Irrigation Systems for Emission Uniformity,
W83-04111 3F

HANDLEY, J.
Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

HANG, A. N.
Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

HANKS, R. J.
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

HANSON, C. L.
Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

HANSON, L. D.
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

HANSON, W. C.
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

HARDEN, D. R.
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

HARGRAVES, P. E.
A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

HARKIN, J. M.
Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

HARMAN, S. A.
Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

HARROLD, D. E.
Extraction of Priority Pollutants From Solids,
W83-03859 5D

HART, M. A.
Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

HARWARD, M. E.
Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

HASSAN, M. M.
Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

HATCH, G. L.
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

HAYES, J. C.
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

HEGEMANN, D. A.
Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

HEINKE, G. W.
Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

HELM, W. T.
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

HERGENRADER, G. L.
Enhancement of Water Quality in Nebraska Farm Ponds by Control of Eutrophication Through Biomanipulation,
W83-03995 5G

HILEMAN, B.
1982 Stockholm Conference on Acidification of the Environment,
W83-04095 5B

HILLEL, D.
A Field Study of Solute Dispersion in a Shallow, Unconfined Aquifer,
W83-04030 2F

Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

HILLIS, P. A.
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

HILTON, J.
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

HIPP, B. W.
Water Conservation With Urban Landscape Plants,
W83-04140 3D

HIROSE, T.
Experience in the Use of Rolled Concrete,
W83-04169 8F

HOLDER-FRANKLIN, M. A.
Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

HOLDRINET, M. V. H.
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

HOLT, C.
Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

HOLTZMAN, R. B.
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

HORING, H.
A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schad-

stoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

HORVATH, D. J.
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

HOSSNER, L. R.
Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

HOTES, F. L.
Financial Aspects of Dam Safety,
W83-04078 8A

HOUIS, J.
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

HOWARD, W. F. JR.
A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

HOWELLS, D. H.
Sediment Pollution Control in North Carolina,
W83-03860 5G

HU, A.
Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

HUCKINS, L. N.
Nitrate in Nevada Playas,
W83-03994 5A

HUGHES, T. C.
Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

HUKKERI, S. B.
Effect of Irrigations Scheduled at Different Stages of Growth on Seed Production of Oat,
W83-04087 3F

HULM, P.
The Regional Seas Program: What Fate for UNEP's Crown Jewels.,
W83-04131 5B

HUNDAL, S. S.
Effect of Dry-Season Soil Management of Water Conservation for the Succeeding Rice Crop in a Tropical Soil,
W83-04066 3F

ILIAS, S.
Effect of Diffusional Resistances on the Performance of Substrate Inhibited Immobilized Enzymatic CFSTR Systems,
W83-04187 5D

INGRAHAM, N. L.
Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

INMAN, J. C.
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

INNISS, W. E.
Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

IRWIN, R. W.
Early Developments in Drainage Engineering,
W83-04135 4A

ITO, K.
Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

IZUNO, F. T.
Border Ditch Irrigation in Colorado,
W83-03959 3F

JACKSON, E. B.
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

JACKSON, R. E.
The Contamination and Protection of Aquifers,
W83-04020 5B

JACOBSON, R. L.
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

Nitrate in Nevada Playas,
W83-03994 5A

JAGNER, D.
Potentiometric Stripping Analysis for Mercury After Preconcentration in a Potassium Permanganate Trap,
W83-04126 5A

JAIN, T. C.
Planning for Increased Crop Production Under Limited Water Resources in Arid and Semi-Arid Conditions,
W83-03868 3F

JAMISON, A.
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

JANOVY, J. JR.
Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

JAY, F. M. S.
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

JEFFRIES, C.
Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

JEKEL, M. R.
Use of Particle Size Analysis in Drinking Water Preparation (Zum Einsatz Von Partikelgrossenanalysen In Der Trinkwasseraufbereitung),
W83-04091 5A

JENSEN, W. P.
Phosphate Extraction Using Fly Ash,
W83-03913 5F

JEPPSON, R. W.
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

JINNO, K.
Determination of Deuterium Oxide in Water by Reversed-Phase High-Performance Liquid Chromatography,
W83-04190 5A

JIRKA, G. H.
Multiport Diffusers for Heat Disposal: A Summary,
W83-03864 8B

JOHNSON, A. H.
Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

JOHNSON, M. L.
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

JOHNSON, R. C.
The Influence of Water Availability on Winter Wheat Yields,
W83-04102 3F

JOHNSTON, D. W.
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

JOHNSTONE, D. W. M.
Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

JONES, E. R.
Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

JONES, J. G.
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

JONES, M.
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

JOO-HWA TAY, A.
Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

JOSHI, D. C.
Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

JURY, W. A.
Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

KAARET, T.
Zooplankton Diversity and Biomass in Recently Acidified Lakes,
W83-04103 2H

KACHANOSKI, R. G.
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

KALLA, A. K.
Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

KANEMASU, E. T.
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

The Influence of Water Availability on Winter Wheat Yields,
W83-04102 3F

Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

KARLINGER, M. R.
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

KEEFER, G. B.
Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

KEEFER, R. F.
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

KEENAN, J. D.
Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

KELLER, D. M.
Adsorption of Radium-226 by Biological Origin Absorbents,
W83-04114 5D

KELLY, M. G.
Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

KELSEY, H. M.
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

KEMSLEY, S.
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

KEUNE, H.
Legal Limits for 'Excessive' Threshhold Levels for Companies Indirectly Discharging Wastewater (Rechtliche Grenzen Fur Grenzwerte Bei Indirekteinleitern),
W83-03943 6E

KHERA, K. L.
Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

KHORRAM, S.
The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

KIEFER, B.
The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

KIM, D. -C.
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

KLEI, H. E.
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

KLEMES, V.
The Essence of Mathematical Models of Reservoir Storage,
W83-03852 4A

KLOKE, A.
Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

KNOX, K.
Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

KOCH, R.
Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

A Threshold Concept of Environmental Pollutants,
W83-04057 5C

KRASOVSKII, G. N.
Principals of Ecological and Hygienic Regulation of Water Quality,
W83-03950 6E

KRINGSTAD, K. P.
Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

KRISTENSEN, G. H.
Precipitation of Calcium Phosphate and pH-Effects in Denitrifying Biofilms,
W83-03952 5D

KROLL, D. G.
Effects of Detergent Formulation on the Performance of Septic Systems,
W83-03924 5B

KROSZYNSKI, U. I.
Long-Time Evolution of an Unstable Water-Wave Train,
W83-03855 2H

KUENZLER, E. J.
Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

KUMMLER, R. H.
Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

KUNZE, R. J.
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

KURTH, G.
An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

KUSHNER, D. J.
Mercury Speciation in Water,
W83-04105 5B

KUZNETSOV, V. S.
Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

LAIRD, D.
Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

LAL, B.
Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

LAL, F.
A Study on the Evaluation of Water Quality With Respect to Boron for Wheat and Barley Growth on Loamy Sand Soil,
W83-03870 5C

LAL, M.
Effect of Irrigations Scheduled at Different Stages of Growth on Seed Production of Oat,
W83-04087 3F

LAL, P.
A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

A Study on the Evaluation of Water Quality With Respect to Boron for Wheat and Barley Growth on Loamy Sand Soil,
W83-03870 5C

LANCE, J. C.
Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

LAND, L. F.
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

LANDSBERGER, S.
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

LARSON, D. C.
Johnson Velocity Meter System Proves its Worth,
W83-04076 8B

LARSON, D. T.
An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

LASCANO, R. J.
Spatial Variability of Soil Hydraulics and Remotely Sensed Soil Parameters,
W83-04062 2G

LASENBY, D. C.
Relationship Between Body-Lead Concentration of Mysis Relicta and Sediment-Lead Concentration in Kootenay Lake, B.C.,
W83-04104 5C

LAU, L. S.
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

LAVY, T. L.
Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

LEATHAM, S.
Nitrate in Nevada Playas,
W83-03994 5A

LEBOFF, J. P.
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

LECOMTE, R.
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

LEDERER, D. O.
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

LEE, E. S.
Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

LEE-STADELMANN, O.
Drought Hardening of Crop Plants,
W83-04150 2I

LEGUBE, B.
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

LELAND, D. F.
A Field Study of Solute Dispersion in a Shallow, Unconfined Aquifer,
W83-04030 2F

LEMLEY, A. T.
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

LEMMER, H. R.
Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

LEPELE, M. J.
Quantification of Soil Loss and Sediment Produced From Eroded Land,
W83-04037 2J

LETOKHOV, V. S.
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

LEWIS, D. T.
Quantification of Soil Loss and Sediment Produced From Eroded Land,
W83-04037 2J

LEYDEN, D. E.
Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

LIANG, C. -S.
Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

LICK, W.
Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

LIGON, J. T.
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

LILLEVIK, S. L.
Discrete-Time, Cutback Furrow Irrigation,
W83-03958 3F

LIMBURG, P. L.
Biphase Turbine for Reverse Osmosis Desalination,
W83-03910 8C

LINDAU, C. W.
Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

LINDSAY, J. I.
Runoff and Soil Loss in Trinidad Under Different Crops and Soil Management,
W83-04028 4D

LINES, G. C.
Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

LINVILL, D. F.
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

LIU, C. C. K.
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

LJUNGQUIST, P. O.
Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

LLOYD, A.
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

LOTH, P.
The Use of Glass-Fiber Paper in Water analyses. Part 1: Properties, Preparation, Rinsing and Scouring Losses (Verwendung Von Glasfaserpapier in Der Wasser-Analytik. Teil 1: Eigenschaften, Vorbereitung, Abspul- Und Auswaschverluste).
W83-04050 5A

LOUDIERE, D.
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

LUNDSTROM, J. E.
Solar Powered Electrodialysis - Part II,
W83-03921 3A

LYNCH, J. D.
Solar Powered Electrodialysis - Part II,
W83-03921 3A

MAASE, D. L.
Polycyclic Aromatic Hydrocarbons-Are They a Problem in Processed Oil Shales,
W83-04148 5B

MABEY, W. R.
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

MACCARY, L. M.
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

MACDONALD, E. M.
Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

MAGNUSON, J. J.
Low pH and the Absence of Fish Species in Naturally Acidic Wisconsin Lakes: Inferences for Cultural Acidification,
W83-04108 5C

MAHAN, K. I.
Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

MAHONEY, D.
Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

MALI, G. C.
A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

MALIWAL, G. L.
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

MANNERING, J. V.
Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

MANNING, D. C.
The Determination of Trace Elements in Natural Waters Using the Stabilized Temperature Platform Furnace,
W83-04118 5A

MARCHANT, R.
Seasonal Variation in the Macroinvertebrate Fauna of Billabongs Along Magela Creek, Northern Territory,
W83-03891 2H

MARKISH, M. S.
Optimal Control of the Caspian Sea Level,
W83-03949 4A

MARROSU, G.
Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

MATHESON, A. T.
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

MATHEWES, R. W.
Historic Changes in an Urban Watershed Determined by Pollen and Geochemical Analyses of Lake Sediment,
W83-04110 5C

MAYFIELD, C. I.
Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

MCCARTER, J. A.
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

MCCARTHY, G. J.
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

MCCRAY, S.
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

MCCUTCHAN, J. W.
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

MCDANIEL, J.
Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

MCGARVEY, F. X.
The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

MCINTOSH, M. S.
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

MCKEAGUE, J. A.
Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

MCKEE, M.
Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

MCPHERSON, M. B.
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

MCTIGHE, T. C.
Reducing the Formation of Trihalomethanes,
W83-03997 5F

MEEK, B.
Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

MEIER, M. F.
Glaciers as a Water Resource,
W83-04021 2C

MELACK, J. M.
Assessment of Acidity of Lakes and Precipitation in the Sierra Nevada,
W83-03911 5B

MELMED, L. N.
Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

MERKEL, B.
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

MESSER, J. J.
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

MEYER, L. D.
A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

MIFFLIN, M. D.
Reuse Versus Return Flows: Considerations for Selecting a Water Supply Strategy,
W83-04001 6B

MILL, T.
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

MILLER, D. E.
Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

MILLER, E.
Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

MINEAR, R. A.
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

MING-TANG, Y.
Low Energy Filtration Using Buoyant Media,
W83-04149 5D

MIRANOWSKI, J. A.
Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

MITCHELL, J. K.
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

MIYAKAWA, S.
Characteristics of Generators for Small Capacity Schemes,
W83-04168 8C

MOESLUND, B.
Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

MOK, B. S.
Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

MOLDENHAUER, W. C.
Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

MOLNAU, M.
Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

MONARO, S.
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

MOORE, R. W. JR.
Clarifying Geothermal Fluids,
W83-04052 5F

MORGAN, K. M.
Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

MORRIS, R. P.
Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

MORRISH, A.
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

MORRISON, A.
EPA's New Land Disposal Rules-A Closer Look,
W83-04100 5E

MORRISON, S. D.
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California
W83-04012 7C

MORROW, C. M.
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

MOTOMIZU, S.
Spectrophotometric Determination of Phosphate in River Waters With Molybdate and Malachite Green,
W83-04128 5A

MRKVA, M.
Evaluation of Correlations Between Absorbance at 254 NM and Cod of River Waters,
W83-03934 5A

MULHERN, B. M.
Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

MUNEMORI, M.
Continuous Flow Determination of Free Chlorine in Water,
W83-04192 5A

MUNGER, J. W.
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

NAIMAN, R. J.
Characteristics of Sediment and Organic Carbon Export From Pristine Boreal Forest Watersheds,
W83-04109 2E

NAKAMURA, B. C.
Economic Optimization of Irrigation,
W83-04007 3F

NALEPA, R.
Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

NARAYANA, D. V. V.
Drainage Requirements of Salt Affected Soils,
W83-03886 4A

NARAYANAN, R.
Drought Management Concepts: Lessons of the 1976-77 U. S. Drought,
W83-03922 6D

An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

NEELY, W. C.
Factors Affecting the Catalytic and Photolytic Enhancement of Ozonization in Water Solutions,
W83-03901 5F

NEILSEN, G. H.
Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

NELSON, A. G.
Economic Optimization of Irrigation,
W83-04007 3F

NELSON, P. O.
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

NELSON, W. H.
A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

NEMETH, G.
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

NEUMAN, S. P.
Estimation of Aquifer Transmissivities Using Numerical Models,
W83-04157 2F

NEWMAN, K. W.
Predicting Depth to the Water Table Based on Species Presence on an Oregon Coast Deflation Plain,
W83-04193 2F

NEWTON, J. G.
Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

NIELSEN, K. C.
Economic Optimization of Irrigation,
W83-04007 3F

NNAJI, S.
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

NOBE, K.
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

NOSS, R. R.
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

NUSS, G. S.
Economic Optimization of Irrigation,
W83-04007 3F

O'CONNOR, W. P.
Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

OEY, H. S.
Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

OLAFSON, R. W.
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

OLIVO, R.
Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

OLSON, R. V.
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

OSSEYRANE, M.
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

OSTENDORF, D. W.
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

OSTERKAMP, W. R.
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

OSTRY, R. C.
Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

OTOMO, M.
Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

OWENS, R.
A U.S. Test for Insituform; or, How to Rebuild Pipe from Within,
W83-04130 8G

PADHIYAR, B. P.
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

PAETH, R. C.
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

PARADIS, P.
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

PAREEK, O. P.
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

PARKS, S. W.
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

PARR, A. D.
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

PASQUINI, R.
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

PATEL, P. T.
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

PATRIZI, K. S.
Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

PEARLMUTTER, N. L.
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

PEARSON, F. H.
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

PENMAN, A. D. M.
Material for Embankment Dams,
W83-04081 8D

PERFETTI, J.
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

PERROUX, K. M.
Wetting Moisture Characteristic Curves Derived From Constant-Rate Infiltration into Thin Soil Samples,
W83-04042 2G

PETERKA, J. J.
Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

PETERSON, D. L.
Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

PETTY, R. L.
Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

PICKERING, N.
Evaluating Low-Volume Irrigation Systems for Emission Uniformity,
W83-04111 3F

PICKERING, W. F.
The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

PIKE, E. B.
Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

PODMORE, T. H.
Border Ditch Irrigation in Colorado,
W83-03959 3F

POLPRASERT, C.
Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

POTGIETER, D. J. J.
Biochemical Changes Associated With Luxury Phosphate Uptake in a Modified Phoredox Activated Sludge System,
W83-03953 5D

POWERS, W. L.
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

PRASAD, S. N.
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

PRASADA RAO, G. S. L. H. V.
Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

PREDIERI, G.
Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some

Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

PREPAS, E. E.
Evaluation of the Phosphorus-Chlorophyll Relationship for Lakes off the Precambrian Shield in Western Canada,
W83-04107 2H

Total Dissolved Solids as a Predictor of Lake Biomass and Productivity,
W83-04106 5C

PRICE, D. R.
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

PRINGLE, W. C.
Analysis of Chemistry Associated With Ozonolysis of Organic Pollutant Molecules in Water,
W83-04141 5A

PRUITT, W. O.
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

PUENTE, C.
Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

PUKITE, A.
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

RAATS, P. A. C.
Wetting Moisture Characteristic Curves Derived From Constant-Rate Infiltration into Thin Soil Samples,
W83-04042 2G

RADAYEV, V. N.
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

RAHEL, F. J.
Low pH and the Absence of Fish Species in Naturally Acidic Wisconsin Lakes: Inferences for Cultural Acidification,
W83-04108 5C

RAI, L. C.
Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

RAI, M.
Impact of Saline Water Irrigation on Some Crops and Their Varieties,
W83-03885 3C

RAKHECHA, P. R.
On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

RAMAMOORTHY, S.
Mercury Speciation in Water,
W83-04105 5B

RAMAN, A. V.
Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

RANDOLPH, J.
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

RANDTKE, S. J.
Formation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

RANSFORD, G. D.
P.I.D. Regulation Revisited,
W83-04080 6B

RAO, A. R.
Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

RAWLS, W. J.
An Infiltration Based Runoff Model for a Standardized 24-Hour Rainfall,
W83-03961 2A

REARDON, J. C.
Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

RENWICK, W. H.
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

RHOTON, F. E.
A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

RICHARDSON, L. B.
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

RICKARD, W. H.
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

RILEY, G. A.
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

RIPLEY, B. D.
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

RISSMANN, E. F.
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

RITTMANN, B. E.
Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

RITZ, D. A.
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

ROBBINS, J. W. D.
Role of Mycorrhizae in Land Application of Municipal Wastewaters,
W83-04154 3C

ROBBINS, K. D.
Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

ROBERTS, M. H.
Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

ROBINSON, J. W.
Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

ROBINSON, P. J.
Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

ROCH, M.
Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

ROGERS, D.
Deep Tank Aeration/Flotation, Clarification Adds a New Treatment Dimension,
W83-04085 5D

ROHMANN, U.
Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

ROJIANI, K. B.
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

ROLFE, G. L.
Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

ROLSTON, D. E.
Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

ROMERO, B. R.
Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

RONAYNE, M. P.
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

ROOTS, E. F.
Glaciers as a Water Resource,
W83-04021 2C

ROSENBERG, N. J.
Agricultural Meteorology in China,
W83-03851 2B

ROSS, B. B.
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

ROSS, J. D.
Interflow of Water Through a Sloping Soil With Seepage Face,
W83-04040 2G

ROWE, R. R.
Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

ROYER, L.
Variations of the Fraser River Plume and Their Relationship to Forcing by Tide, Wind and Discharge,
W83-04117 2L

RUNDLE, H.
Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

SACK, W. A.
Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

SALANITRO, J. P.
Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

SALZWEDEL, J.
Groundwater Protection - Sufficient Against Threats to Public Water Supply Due to Groundwater Pollution. (Grundwasser-Schutz - Austreichend Angesichts Der Bedrohung Der Offentlichen Wasserversorgung Durch Grundwasserverunreinigungen.),
W83-04093 5B

SANDHU, B. S.
Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

SANDHU, S. S.
Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

SANTO, L. T.
Comments on 'A Trickle Irrigation System for Frequent Application of Nitrogen to Experimental Plots', and Reply to Comments,
W83-04033 3F

SCARBOROUGH, J. N.
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

SCASSELLATI SFORZOLINI, G.
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

SCHEPERS, J. S.
Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

SCHIELDS, P. J.
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

SCHROEDER, E. D.
Physical Design of Overland Flow Systems,
W83-04180 5E

SCHROEDER, E. E.
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

SCHROEDER, S. A.
Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

SCHUSTER, H.
Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

SCHUTTE, C. F.
Water Recycling for Domestic and Agricultural Applications: State of the Art,
W83-03969 3C

SCHWILLE, F.
Flow Processes in the Fissure Network Model (Stromungsvorgange Im Vermaschten Kluftmodell),
W83-04092 2F

SCOTT, E. C.
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

SCOTT, H. D.
Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

SEIDLER, R. J.
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

SELLECK, R. E.
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

SELLEK, J. W.
The Operation, Maintenance and Renovation of Sewerage Systems and Pumping Stations in a Large Municipality,
W83-03929 5D

SEMMENS, M. J.
Low Energy Filtration Using Buoyant Media,
W83-04149 5D

SHACKELFORD, W. M.
An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

SHAH, C. B.
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

SHANHOLTZ, V. O.
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

SHANK, R.
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

SHARMA, K. D.
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

SHARMA, R. C.
Ionic Composition of Ground Waters in Jind District (Haryana) and Their Suitability for Crop Growth,
W83-03866 3C

SHARMA, V. C.
Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

SHARP, R. D.
A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models,
W83-03978 5B

SHARPLEY, A. N.
Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

SHEETS, P. J.
Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

SHIEL, R. J.
Plankton of the Lower River Murray, South Australia,
W83-03892 5C

SHIMP, G. F.
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

SHIZUMURA, L.
Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

SHUKLA, N. P.
Effect of Irrigations Scheduled at Different Stages of Growth on Seed Production of Oat,
W83-04087 3F

SHUVAL, H. I.
Health Risks Associated With Water Recycling,
W83-03971 3C

SIEMER, D. D.
Determination of Mercury in Water by Furnace Atomic Absorption Spectrometry After Reduction and Aeration,
W83-04123 5A

SIMPSON, B.
Water Conservation With Urban Landscape Plants,
W83-04140 3D

SIMPSON, E. S.
Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

SINGH, B.
Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

SINGH, G.
Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

SINGH, H. P.
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

SINGH, I. M.
Reducing the Formation of Trihalomethanes,
W83-03997 5F

SINGH, K. S.
A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

SINGH, R. N.
Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

SINGH, R. P.
Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

SINGH, S.
A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

SINGH, V. P.
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

SIPP, S. K.
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

SIRONS, G. J.
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

SLAVIN, W.
The Determination of Trace Elements in Natural Waters Using the Stabilized Temperature Platform Furnace,
W83-04118 5A

SMILES, D. E.
Wetting Moisture Characteristic Curves Derived From Constant-Rate Infiltration into Thin Soil Samples,
W83-04042 2G

SMITH, R. G.
Physical Design of Overland Flow Systems,
W83-04180 5E

SNIPES, D. S.
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

SOCHA, M. M.
Solar Powered Electrodialysis - Part II,
W83-03921 3A

SONTHEIMER, H.
Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

SOTTON, M.
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

SPACIE, A.
Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

SPEARING, B. W.
Effective Use of STOM,
W83-03931 5D

SPOSITO, G.
Internal Energy Balance and the Richards Equation,
W83-04027 2G

SRIVASTAVA, K. K.
Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

STADELMANN, E. J.
Drought Hardening of Crop Plants,
W83-04150 2I

STAFFORD, D. B.
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

STAVOLA, A. M.
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

STEPHENS, T. A.
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

STEWART, M. T.
Evaluation of a Ground Transient Electromagnetic Remote Sensing Method for the Deep Detection and Monitoring of Salt Water Interfaces,
W83-03899 7B

STIASSNIE, M.
Long-Time Evolution of an Unstable Water-Wave Train,
W83-03855 2H

STOLZY, L. H.
Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

STONE, K. L.
Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

STONE, L. R.
Movement of Water and Nitrate-Nitrogen in a Typical Silt Loam Soil of Western Kansas,
W83-03908 5G

STONE, S.
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

STRAUGHAN, I. R.
Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

STROBEL, K.
A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

STROMAN, M.
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

STROMBERG, L. M.
Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

STURM, T. W.
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

SUBRAMANIAM, A. R.
Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

SUD, Y. C.
An Observational-Data Based Evapotranspiration Function for General Circulation Models,
W83-04116 2D

SUDDUTH, K. A.
Computer Aid for Terrace Location,
W83-03957 4D

SUN, P. T.
Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

SUNDSTROM, D. W.
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

SUOZZO, R.
Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

SUTOVSKAYA, I. V.
Principals of Ecological and Hygienic Regulation of Water Quality,
W83-03950 6E

SVORCOVA, L.
Influence of UV Radiation on the Microflora of Water With Different Degrees of Mineralization (Einfluss Der UV-Strahlung Auf Die Mikroflora Verschieden Mineralisierter Wasser),
W83-04046 5F

SWAIN, R.
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

SWALLOW, C. W.
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

SWANSON, K. D.
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

SWANSON, S. A.
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

SWARTZENDRUBER, D.
Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

SWIGERT, J. P.
Survival and Growth of Warmwater Fishes Exposed to Ammonia Under Low Flow Conditions,
W83-03923 5C

TAK, T. C.
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

TALBOT, V.
Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

TARAPCHAK, S. J.
Soluble Reactive Phosphorus Measurements in Lake Water: Evidence for Molybdate-Enhanced Hydrolysis,
W83-03977 5A

TAYLOR, R. L.
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

TERNERO, M.
Determination of Trace Amounts of Molybdenum in Natural Waters by Solvent Extraction-Atomic-Absorption Spectrometry, After Chelating Ion-Exchange Preconcentration,
W83-04127 5A

TERRY, R. V.
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

THANH, N. C.
Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

THERRIEN, D.
Environmental Corrective Programs at the La Grande Complex (Les Amenagements Correctifs D'Environnement Au Complexe La Grande),
W83-04060 6G

THOMAS, A. W.
Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

THORNE, M. D.
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

THORNTON, J. B.
Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

THURTELL, G. W.
An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

THYSSEN, N.
Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

TISON, D. L.
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

TOEI, K.
Spectrophotometric Determination of Phosphate in River Waters With Molybdate and Malachite Green,
W83-04128 5A

TOLLNER, E. W.
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

TOPP, G. C.
Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

TOY, D. W.
Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

TRAMONTINI, E. M.
Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

TRAZZA, A.
Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

TREW, D. O.
Evaluation of the Phosphorus-Chlorophyll Relationship for Lakes off the Precambrian Shield in Western Canada,
W83-04107 2H

TSAI, C.-F.
Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

TSE, D.
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

TSEZOS, M.
Adsorption of Radium-226 by Biological Origin Absorbents,
W83-04114 5D

TUCOVIC, I. V.
The Seismic Behaviour of Gravity Dams Founded on Low Shear Strength Soil,
W83-04084 8G

TUNTOOLAVEST, M.
Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

TURNER, R. R.
Coal Conversion Solid Waste Disposal,
W83-03858 5E

TWEDELL, A. M.
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

UBELL, K.
Flow Processes in the Fissure Network Model (Stromungsvorgange Im Vermaschten Kluftmodell),
W83-04092 2F

UBERTINI, L.
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

UDLUFT, P.
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

UEBLER, R. L.
Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

UEDA, T.
Large Capacity Bulb Units in Japan,
W83-04166 8C

UNGER, P. W.
Time and Frequency of Irrigation Effects on Sunflower Production and Water Use,
W83-04039 3F

VAN BAVEL, C. H. M.
Spatial Variability of Soil Hydraulics and Remotely Sensed Soil Parameters,
W83-04062 2G

VAN DEN BROEK, H. H.
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

VAN, H. N. N.
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

VAN VLIET, L. J. P.
Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

VASILIKIOTIS, G.
Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

VASILIKIOTIS, G. S.
Concentration of Heavy Metals in Seawater and Sediments from the Northern Aegean Sea, Greece,
W83-04056 5B

VAUX, H. J. JR.
Evaluating Low-Volume Irrigation Systems for Emission Uniformity,
W83-04111 3F

Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

VENEMAN, P. L. M.
Chemical and Morphological Soil Characteristics in a New England Drainage-Toposequence,
W83-04036 2G

VERMA, C. M.
Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

VIDAL, J. C.
Spectrophotometric and Fluorimetric Determination of Boron in Soils, Plants and Water by Extraction with 2-Methylpentane-2,4-Diol in Isobutyl Methyl Ketone,
W83-04129 5A

VIGG, S. C.
Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

VIVONA, M. A.
Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

VOLK, V. V.
Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

VRIESEMA, R.
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

WAKIMOTO, T.
Spectrophotometric Determination of Phosphate in River Waters With Molybdate and Malachite Green,
W83-04128 5A

WALKER, K. F.
Plankton of the Lower River Murray, South Australia,
W83-03892 5C

WALKER, P. N.
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

WALL, G. J.
Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

WALLIS, D. A.
Biological Regeneration of Activated Carbon,
W83-04133 5D

WANG, C.
Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

WANG, D. -S.
Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

WARD, T. J.
The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

WARINNER, J. E. JR.
Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

WEGMAN, R. C. C.
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

WHALEN, G. A.
Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

WHEATCRAFT, S. W.
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

WHISLER, F. D.
A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

WHITE, I.
Design for a Field Sprinkler Infiltrometer,
W83-04072 3F

WIEDENHEFT, W. D.
Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

WIEMER, B.
A Proposed Routine Method for Determining Polycyclic Aromatic Hydrocarbons (Vorschlag Fur Eine Routinemethode Zur Bestimmung Polycyclischer Aromatischer Kohlenwasserstoffe),
W83-04047 5A

WILDISH, D. J.
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

WILLIAMS, W. D.
Plankton of the Lower River Murray, South Australia,
W83-03892 5C

WILLIAMS, W. T.
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

WILSON, J. D.
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

WILSON, S. A.
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

WISCHNER, R.
Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

WITTMUSS, H. D.
Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

WOESTE, F. E.
A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

WOLANSKI, E.
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

WOLF, D. C.
Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

WONG, P. T. S.
Toxicity of pH, Heavy Metals and Bisulfite to a Freshwater Green Alga,
W83-04054 5C

WRIGHT, D.
Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

YADAV, R. C.
Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

YANG, E.
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

YANG, V.
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

YASUDA, H.
A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

YEGOROV, A. S.
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

YOO, K. H.
Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

YOUNG, J. C.
Extraction of Priority Pollutants From Solids,
W83-03859 5D

YOUNG, P. C.
The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

YOUNG, P. W.
Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

ZACHARIAH, M.
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

ZEGELIN, S. J.
Design for a Field Sprinkler Infiltrometer,
W83-04072 3F

ZIARKOWSKI, S. M.
The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

ZOTOU, A.
Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

ORGANIZATIONAL INDEX

AARHUS UNIV. (DENMARK). DEPT. OF CHEMISTRY.
Single-Drop Tensammetry,
W83-04125 5A

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, BENEDICT, MD. BENEDICT ESTUARINE RESEARCH LAB.
Lethal and Sublethal Exposure and Recovery Effects of Ozone-Produced Oxidants on Adult White Perch (Morone Americana Gmelin),
W83-03932 5C

ADELAIDE UNIV. (AUSTRALIA). DEPT. OF BOTANY.
The Influence of Previous Light History on the Respiration of Four Species of Freshwater Phytoplankton,
W83-03874 5C

ADELAIDE UNIV. (AUSTRALIA). DEPT. OF ZOOLOGY.
Plankton of the Lower River Murray, South Australia,
W83-03892 5C

AGRICULTURAL RESEARCH AND EDUCATION CENTER, LAKE ALFRED, FL.
Estimating the Potential for Ochre Clogging Before Installing Drains,
W83-03975 4A

AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MD.
An Infiltration Based Runoff Model for a Standardized 24-Hour Rainfall,
W83-03961 2A

AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MD. HYDROLOGY LAB.
Comparative Movement of Different Enteroviruses in Soil Columns,
W83-03984 5B

AGRICULTURAL RESEARCH SERVICE, BOISE, ID. NORTHWEST WATERSHED RESEARCH CENTER.
Precipitation-Duration-Frequency Relationships for a Mountainous Watershed in Southwest Idaho,
W83-03974 2B

AGRICULTURAL RESEARCH SERVICE, DURANT, OK. WATER QUALITY AND WATERSHED RESEARCH LAB.
Interflow of Water Through a Sloping Soil With Seepage Face,
W83-04040 2G

AGRICULTURAL RESEARCH SERVICE, LINCOLN, NE.
Chemical Water Quality of Runoff From Grazing Land in Nebraska: II Contributing Factors,
W83-03967 5B

Chemical Water Quality of Runoff From Grazing Land in Nebraska: I. Influence of Grazing Livestock,
W83-03981 5B

AGRICULTURAL RESEARCH SERVICE, OXFORD, MS. SEDIMENTATION LAB.
Investigations of Vegetation for Stabilizing Eroding Streambanks,
W83-03960 4D

A Laboratory Method for Predicting the Size Distribution of Sediment Eroded from Surface Soils,
W83-04067 2J

AGRICULTURAL RESEARCH SERVICE, PHOENIX, AZ. WATER CONSERVATION LAB.
Residual-Wax Soil Treatments for Water Harvesting,
W83-04038 3B

AGRICULTURAL RESEARCH SERVICE, SHAFTER, CA. COTTON RESEARCH STATION.
Long-Term Effects of Manure on Soil Nitrogen, Phosphorus, Potassium, Sodium, Organic Matter, and Water Infiltration Rate,
W83-04043 2G

AKADEMIYA NAUK SSSR, MOSCOW. INST. SPEKTROSKOPII.
Direct Determination of Aluminium in Natural Waters by Laser Stepwise Photoionization,
W83-04016 5A

ALBERTA ENVIRONMENTAL CENTER, VEGREVILLE.
Mercury Speciation in Water,
W83-04105 5B

ALBERTA UNIV., EDMONTON. DEPT. OF ZOOLOGY.
Total Dissolved Solids as a Predictor of Lake Biomass and Productivity,
W83-04106 5C

Evaluation of the Phosphorus-Chlorophyll Relationship for Lakes off the Precambrian Shield in Western Canada,
W83-04107 2H

AMERICAN UNIV., WASHINGTON, DC. DEPT. OF BIOLOGY.
Concentrations of Organic Phosphate, Nitrogen, and Carbon in Storm Runoff and Combined Sewers in the Greater Washington, D.C. Area,
W83-04159 5B

AMETEK, INC., SHEBOYGAN, WI. PLYMOUTH PRODUCTS DIV.
Determining Residual Chlorine: Effect of Temperature on the Titrametric Starch-Iodine End Point,
W83-04176 5A

ANDHRA UNIV., WALTAIR (INDIA). DEPT. OF METEOROLOGY AND OCEANOGRAPHY.
Meridional Variation of Water Balance in Rajasthan State,
W83-03881 2A

Climatic Study of Water Balance, Aridity, and Droughts in Rajasthan State,
W83-03884 2B

ANDHRA UNIV., WALTAIR (INDIA). DEPT. OF ZOOLOGY.
Pollution Effects on Ecobiology of Benthic Polychaetes in Visakhapatnam Harbour (Bay of Bengal),
W83-04165 5C

ANGLIAN WATER AUTHORITY, NORWICH (ENGLAND). NORWICH SEWAGE DIV.
Initial Operating Experiences of Uprating Diss Sewage Treatment Works Using the Boc Vitox System,
W83-03946 5D

ARBER (RICHARD P.) ASSOCIATES, INC., DENVER, CO.
From Wastewater to Drinking Water,
W83-04099 5D

ARIZONA STATE UNIV., TEMPE. DEPT. OF ZOOLOGY.
Water Quality and Nutrient Dynamics of Arizona Streams,
W83-03900 5B

ARIZONA UNIV., TUCSON. DEPT. OF ELECTRICAL ENGINEERING.
Analysis of the Plant Soil Continuum Using Electrophytograms, Phase II,
W83-04136 3F

ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.
Estimation of Aquifer Transmissivities Using Numerical Models,
W83-04157 2F

ARIZONA WATER RESOURCES RESEARCH CENTER, TUCSON.
Predicting Discharge on Ungaged Streams from Rainfall Measurements in Southern Arizona,
W83-04137 2A

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF AGRONOMY.
Adsorption and Degradation of Phenol at Low Concentrations in Soil,
W83-03980 5B

ASIAN INST. OF TECH., BANGKOK (THAILAND). DIV. OF ENVIRONMENTAL ENGINEERING.
Bacterial Die-Off Kinetics in Waste Stabilization Ponds,
W83-04182 5D

AUBURN UNIV., AL. DEPT. OF CHEMISTRY.
Factors Affecting the Catalytic and Photolytic Enhancement of Ozonization in Water Solutions,
W83-03901 5F

AUSTRALIAN INST. OF MARINE SCIENCES, TOWNSVILLE.
Physical Properties of Great Barrier Reef Lagoon Waters Near Townsville. II. Seasonal Variations,
W83-03880 2L

BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA.
The Non-Fisheries Biological Resources of the Hanford Reach of the Columbia River,
W83-04017 6G

BAYER A.G., LEVERKUSEN (GERMANY, F.R.).
Levasint Coatings. Long-Term Corrosion Prevention Includes the Water Field (Levasint-Beschichtungen. Langzeit-Korrosionsschutz Auch Fur Den Wasser-Bereich),
W83-03939 8G

BINNIE AND PARTNERS, LONDON (ENGLAND).
Water Recycling - Research Needs,
W83-03965 3C

Asphaltic Concrete Membranes in Embankment Dams,
W83-04083 8F

BIOLOGISCHE BUNDESANSTALT FUER LAND- UND FORSTWIRTSCHAFT, BERLIN (GERMANY, F.R.). INST. FOR NON-PARASITIC PLANT DISEASES.
Re-use of Sludges and Treated Waste Water in Agriculture. (Troubles Arising From the Contamination of Soils With Heavy Metals and From Application of Sludges and Treated Waste Water in Agriculture),
W83-03970 5E

BLACK AND VEATCH, DENVER, CO.
Heat Recovery, Flow Equalization, and Alternate Discharge Highlight Awt Expansion,
W83-04178 5D

BONN UNIV. (GERMANY, F.R.). INST. FUER DAS RECHT DER WASSERWIRTSCHAFT.
Groundwater Protection - Sufficient Against Threats to Public Water Supply Due to Groundwater Pollution. (Grundwasser-Schutz - Austreichend Angesichts Der Bedrohung Der Offentlichen Wasserversorgung Durch Grundwasserverunreinigungen.),
W83-04093 5B

BRIDGEPORT HYDRAULIC CO., CT. SYSTEMS OPERATIONS DEPT.
Designing and Constructing the Trap Falls Water Treatment Plant,
W83-04175 5F

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF OCEANOGRAPHY.
Variations of the Fraser River Plume and Their Relationship to Forcing by Tide, Wind and Discharge,
W83-04117 2L

BUNDESANSTALT FUER GEWAESSERKUNDE, COBLENZ (GERMANY, F.R.).
Flow Processes in the Fissure Network Model (Stromungsvorgange Im Vermaschten Kluftmodell),
W83-04092 2F

CALIFORNIA INST. OF TECH., PASADENA. W.M. KECK LAB. OF ENVIRONMENTAL ENGINEERING SCIENCE.
Continental-Scale Variations in Precipitation Chemistry,
W83-04096 2K

CALIFORNIA UNIV., BERKELEY. DEPT. OF FORESTRY AND RESOURCES MANAGEMENT.
Recovery After Logging in Streams With and Without Bufferstrips in Northern California,
W83-03990 4C

CALIFORNIA UNIV., BERKELEY. DEPT. OF PLANT AND SOIL BIOLOGY.
Mobility Through Soils of Certain Heavy Metals in Geothermal Brine Water,
W83-03896 5B

CALIFORNIA UNIV., BERKELEY. SCHOOL OF PUBLIC HEALTH.
Air Stripping of Volatile Organics From Drinking Water,
W83-03991 5F

CALIFORNIA UNIV., DAVIS. DEPT. OF AGRICULTURAL ECONOMICS.
Federal Tax Laws and Soil and Water Conservation,
W83-03857 6E

CALIFORNIA UNIV., DAVIS. DEPT. OF CIVIL ENGINEERING.
Physical Design of Overland Flow Systems,
W83-04180 5E

CALIFORNIA UNIV., DAVIS. DEPT. OF LAND, AIR AND WATER RESOURCES.
Field Measurement of Denitrification: III. Rates During Irrigation Cycles,
W83-04035 3F

Incidental Effects of Agricultural Water Conservation,
W83-04113 3F

CALIFORNIA UNIV., LOS ANGELES. DEPT. OF CHEMICAL, NUCLEAR, AND THERMAL ENGINEERING.
The Effect of Water Pretreatment Chemicals on the Performance and Durability of Reverse Osmosis Membranes,
W83-04143 3A

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
Using 'Blowdown' Water to Irrigate Crops,
W83-04112 3C

CALIFORNIA UNIV., SANTA BARBARA. MARINE SCIENCE INST.
Assessment of Acidity of Lakes and Precipitation in the Sierra Nevada,
W83-03911 5B

CASE WESTERN RESERVE UNIV., CLEVELAND, OH. DEPT. OF GEOLOGICAL SCIENCES.
Release of Polychlorinated Biphenyls From Contaminated Lake Sediments: Flux and Apparent Diffusivities of Four Individual PCBs,
W83-04098 5B

CENTRAL ARID ZONE RESEARCH INST., JODHPUR (INDIA).
Optimum Utilization of Limited Water Resources of Arid Lands for Efficient Crop Production,
W83-03873 3F

Effect of Asphalt Sub-Surface Moisture on Water Characteristics and Productivity of Sand Soil,
W83-03875 3F

Some Hydro-Horticultural Relations in a Ber Orchard (Zizyphus Mauritiana Lamk.),
W83-03882 2A

Studies on Soil Moisture Storage Under Contour Furrow During the Growing Season of Cenchrus Ciliaris,
W83-03883 2G

Planning Soil and Moisture Conservation in Arid Regions of Rajasthan,
W83-03887 3F

Effect of Mulches on Moisture and Thermal Regimes of Soil and Yield of Pearl Millet,
W83-04120 3F

A Proposed Photohydrogeomorphic Technique as an Aid for Faster Exploration of Groundwater Potential Areas in the Indian Arid Zone,
W83-04121 3B

CENTRAL SOIL AND WATER CONSERVATION RESEARCH AND TRAINING INST., DEHRA DUN (INDIA).
Supplemental Irrigation to Wheat From Runoff Harvested Water Under Dry Farming Conditions,
W83-03867 3F

CENTRAL SOIL SALINITY RESEARCH INST., KARNAL (INDIA).
Ionic Composition of Ground Waters in Jind District (Haryana) and Their Suitability for Crop Growth,
W83-03866 3C

Drainage Requirements of Salt Affected Soils,
W83-03886 4A

Note on the Effect of Subsoil Sodicity on the Water Use by Irrigated Wheat,
W83-04089 3F

CHANDRA SHEKAR AZAD UNIV. OF AGRICULTURE AND TECHNOLOGY, KANPUR (INDIA).
Moisture Conservation Efficiency of Some Legumes and Their Effect on the Yield of Rai (Brassica Juncea Coss) Under Rainfed Conditions,
W83-03869 3F

CHULALONGKORN UNIV., BANGKOK (THAILAND). DEPT. OF SANITARY ENGINEERING.
Factors Affecting the Clarification Performance of Activated Sludge Final Settlers,
W83-04177 5D

CLEANAWAY LTD., RAYLEIGH (ENGLAND).
Treatability Studies on Leachate From a Co-Disposal Landfill,
W83-04172 5D

CLEMSON UNIV., SC. DEPT. OF CIVIL ENGINEERING.
Fracture Trace Mapping and Water Well Yield in the Piedmont Region of South Carolina,
W83-03906 7C

Use of Digitized Radar and Microcomputers to Forecast Local Floods and Irrigation Needs,
W83-04158 7C

COASTAL AND MARINE ENGINEERING RESEARCH INST., HAIFA (ISRAEL). DEPT. OF CIVIL ENGINEERING.
Long-Time Evolution of an Unstable Water-Wave Train,
W83-03855 2H

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURAL AND CHEMICAL ENGINEERING.
Border Ditch Irrigation in Colorado,
W83-03959 3F

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA).
Design for a Field Sprinkler Infiltrometer,
W83-04072 3F

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF ENVIRONMENTAL MECHANICS.
Wetting Moisture Characteristic Curves Derived From Constant-Rate Infiltration into Thin Soil Samples,
W83-04042 2G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CRONULLA (AUSTRALIA). DIV. OF FISHERIES RESEARCH.
The Depauperation of Epifauna on Pinna Bicolor Near a Lead Smelter, Spencer Gulf, South Australia,
W83-04174 5C

CONNECTICUT UNIV., STORRS. INST. OF WATER RESOURCES.
Destruction of Hazardous Wastes by Ultraviolet Catalyzed Oxidation,
W83-04002 5D

CORNELL UNIV., ITHACA, NY. SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Multiport Diffusers for Heat Disposal: A Summary,
W83-03864 8B

DEFENCE LAB., JODHPUR (INDIA).
Salinity and Toxicity of Brackish Waters of Arid Zones of Western Rajasthan,
W83-03889 3C

DEPARTMENT OF AGRICULTURE, GUELPH (ONTARIO). INST. OF PEDOLOGY.
Agriculture and Water Quality in the Canadian Great Lakes Basin: II. Fluvial Sediments,
W83-03987 5B

DEPARTMENT OF AGRICULTURE, OTTAWA (ONTARIO). LAND RESOURCE RESEARCH INST.
Agriculture and Water Quality in the Canadian Great Lakes Basin: I. Representative Agricultural Watersheds,
W83-03983 5B

Estimating Saturated Hydraulic Cconductivity from Soil Morphology,
W83-04031 2G

DEPARTMENT OF AGRICULTURE, SUMMERLAND (BRITISH COLUMBIA). RESEARCH STATION.
Agriculture and Water Quality in the Canadian Great Lakes Basin: IV. Nitrogen,
W83-03988 5B

DEPARTMENT OF FISHERIES AND OCEANS, ST. ANDREWS (NEW BRUNSWICK).
Carbon-14 Assimilation by Algal Communities of Oligothrophic Ponds Treated With Formulated Aminocarb,
W83-03876 5C

DISTRICT OF COLUMBIA DEPT. OF ENVIRONMENTAL SERVICES, WASHINGTON. WASTEWATER DIV.
Nitrification Facilities Start-Up and Initial Operation,
W83-04179 5D

DRESDEN FORSCHUNGSZENTRUM WASSERTECHNIK (GERMAN D.R.).
Utilization of Water from the Open-Cast Mines Situated North of Leipzig (Die Nutzung Des Wassers Aus Den Tagebauen Nordlich Leipzigs),
W83-04061 3C

EDDE (HOWARD), INC., BELLEVUE, WA.
Meeting Regulatory Requirements Through Minor Plant Modifications,
W83-04086 5D

ENGINEERING AND CONSULTING CO., BELGRADE (YUGOSLAVIA). DEPT. OF UNDERGROUND STRUCTURES.
The Seismic Behaviour of Gravity Dams Founded on Low Shear Strength Soil,
W83-04084 8G

ENVIROCHEM, PERTH (AUSTRALIA).
Heavy Metals in the Sediments of Cockburn Sound, Western Australia, and its Surrounding Areas,
W83-04173 5B

ENVIRONMENTAL RESEARCH LAB., ATHENS, GA.
An Evaluation of Automated Spectrum Matching for Survey Identification of Wastewater Components by Gas Chromatography-Mass Spectrometry,
W83-04124 5A

ENVIROTECH CORP., SALT LAKE CITY, UT. EIMCO PROCESS MACHINERY DIV.
Clarifying Geothermal Fluids,
W83-04052 5F

EXXON NUCLEAR IDAHO CO., INC., IDAHO FALLS.
Determination of Mercury in Water by Furnace Atomic Absorption Spectrometry After Reduction and Aeration,
W83-04123 5A

FISH AND WILDLIFE SERVICE, LAUREL, MD. PATUXENT WILDLIFE RESEARCH CENTER.
Heavy Metal Concentrations in Earthworms From Soil Amended With Sewage Sludge,
W83-03897 5B

FLORIDA STATE DEPT. OF ENVIRONMENTAL REGULATION, TALLAHASSEE.
Desalting Water in Florida,
W83-04196 3A

FORSCHUNGSINSTITUT FUER MIKROBIOLOGIE UND HYGIENE, BAD ELSTER (GERMAN D.R.).
A Complex System for the Stadardization of Water Pollutants -- Discussion of Proposals Made by Krassovskiy Et Al (Komplexes Schema Zur Normierung Von Wasser Schadstoffen -- Eine Betrachtung Zu Vorschlagen Von Krassovskij Et Al),
W83-04065 6F

FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND).
A Note on the Growth of Thiothrix in Road Drainage Ditches,
W83-04199 5B

FUJI ELECTRIC CO. LTD., KAWASAKI (JAPAN). HYDRO POWER DIV.
Large Capacity Bulb Units in Japan,
W83-04166 8C

GEOLOGICAL SURVEY, AUSTIN, TX. WATER RESOURCES DIV.
Techniques for Estimating the Magnitude and Frequency of Floods in the Dallas-Fort Worth Metropolitan Area, Texas,
W83-04013 2E

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.
Potentially Favorable Areas for Large-Yield Wells in the Red River Formation and Madison Limestone in Parts of Montana, North Dakota, South Dakota, and Wyoming,
W83-04011 3B

GEOLOGICAL SURVEY, LAWRENCE, KS. WATER RESOURCES DIV.
Sediment and Channel-Geometry Investigations for the Kansas River Bank-Stabilization Study, Kansas, Nebraska, and Colorado,
W83-04008 2J

GEOLOGICAL SURVEY, LINCOLN, NE. WATER RESOURCES DIV.
A Statistical Analysis of the Quality of Surface Water in Nebraska,
W83-04014 7C

GEOLOGICAL SURVEY, MIAMI, FL. WATER RESOURCES DIV.
Geologic Map of Redwood Creek Drainage Basin, Humboldt County, California,
W83-04012 7C

GEOLOGICAL SURVEY, SALT LAKE CITY, UT. WATER RESOURCES DIV.
Hydrologic Studies of the U. S. Geological Survey In Major Coal-Resource Areas of Utah through 1980,
W83-04015 10C

GEOLOGICAL SURVEY, TACOMA, WA. WATER RESOURCES DIV.
Modification of the Tangborn Short-Term Hydrometeorological Model, With Trial Results From the Baker River Basin, Washington,
W83-04009 2A

GEOLOGICAL SURVEY, TUSCALOOSA, AL. WATER RESOURCES DIV.
Assessment of Hydrologic Conditions in Potential Coal-Lease Tracts in the Warrior Coal Field, Alabama,
W83-04010 2A

GEORGIA INST. OF TECH., ATLANTA. DEPT. OF CIVIL ENGINEERING.
Ground Water Pumping From Shallow Axisymmetric Ponds,
W83-03863 4B

GEORGIA UNIV., ATHENS. DEPT. OF AGRICULTURAL ENGINEERING.
Sedimentology of Erect Vegetal Filters,
W83-03865 8B

GESELLSCHAFT FUER WIRTSCHAFTSFORDERUNG UND MARKTPLANUNG M.B.H., FRANKFURT AM MAIN (GERMANY, F.R.).
Market Chances for Membrane Procedures in the 1980s (Marktchancen Fur Membranverfahren in Den 80er Jahren),
W83-03941 5D

GOETEBORG UNIV. (SWEDEN). DEPT. OF ANALYTICAL AND MARINE CHEMISTRY.
Potentiometric Stripping Analysis for Mercury After Preconcentration in a Potassium Permanganate Trap,
W83-04126 5A

GUELPH UNIV. (ONTARIO). DEPT. OF LAND RESOURCE SCIENCE.
An Improved Thermocouple Hygrometer for In-Situ Measurements of Soil Water Potential,
W83-04070 7B

GUELPH UNIV. (ONTARIO). SCHOOL OF ENGINEERING.
Early Developments in Drainage Engineering,
W83-04135 4A

GUJARAT AGRICULTURAL UNIV., AHMEDABAD (INDIA).
Effect of Different Mulches on Yield, and Moisture-Use-Efficiency on Tobacco (Nicotiana Tabacum),
W83-03871 3F

HADASSAH MEDICAL SCHOOL, JERUSALEM (ISRAEL). ENVIRONMENTAL HEALTH LAB.
Health Risks Associated With Water Recycling,
W83-03971 3C

HAWAII UNIV., HONOLULU. WATER RESOURCES RESEARCH CENTER.
Formation of Transition Zone in a Basal Aquifer Under Pumping Stresses,
W83-03998 4B

Clostridium Perfringens as an Indicator of Stream Water Quality,
W83-03999 5A

HAWAIIAN SUGAR PLANTERS' ASSOCIATION, AIEA. CROP SCIENCE DEPT.
Comments on 'A Trickle Irrigation System for Frequent Application of Nitrogen to Experimental Plots', and Reply to Comments,
W83-04033 3F

IDAHO UNIV., MOSCOW. DEPT. OF AGRICULTURAL ENGINEERING.
Simulation of Soil Erosion From Winter Runoff in the Palouse Prairie,
W83-03973 2J

ILLINOIS STATE GEOLOGICAL SURVEY DIV., CHAMPAIGN.
Hydrogeologic and Geochemical Studies of Selected Natural Radioisotopes and Barium in Groundwater in Illinois,
W83-03989 2K

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF AGRICULTURAL ENGINEERING.
Soil Erosion Simulation on Small Watersheds: A Modified Answers Model,
W83-03963 2J

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF CIVIL ENGINEERING.
Temperature Effects on Oxygen Transfer to Rotating Biological Contactors,
W83-04181 5D

IMS ENGINEERS, FAIRPORT, NY.
Reducing the Formation of Trihalomethanes,
W83-03997 5F

INDIAN COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.
Planning for Increased Crop Production Under Limited Water Resources in Arid and Semi-Arid Conditions,
W83-03868 3F

INDIAN GRASSLAND AND FODDER RESEARCH INST.. JHANSI.
Effect of Irrigations Scheduled at Different Stages of Growth on Seed Production of Oat,
W83-04087 3F

INDIAN INST. OF TROPICAL METEOROLOGY, POONA.
On Some Hydrometeorological Aspects of Heavy Rainfall Distribution Over the Principal Arid Zone of Rajasthan,
W83-03872 2B

INSTITUT FUER ENERGETIK, LEIPZIG (GERMAN D.R.).
Experience in the Field of Oil Removal From Power Plant Wastewaters (Erfahrungen Auf Dem Gebiet Der Entolung Von Kraftwerkabwassern),
W83-04048 5D

INSTITUT FUER WASSERWIRTSCHAFT, BERLIN (GERMAN D.R.).
On Relationships Between Stochastical Characteristics of an Aquatic Ecosystem and its Entropy Production,
W83-04045 2H

INSTITUTE FOR SOIL FERTILITY, GRONINGEN (NETHERLANDS). DEPT. OF SOIL BIOLOGY.
Effect of Sewage Sludge on Trace Element Mobility in Soils,
W83-03893 5B

INSTITUTE OF HYGIENE, GERA (GERMAN, D.R.).
Organohalogenes as Carcinogens in Drinking Water (Organohalogene Als Karzinogene Im Trinkwasser),
W83-04064 5C

INSTITUTE OF HYGIENE, GERA (GERMAN, D.R.). DEPT. OF TOXICOLOGY.
A Threshold Concept of Environmental Pollutants,
W83-04057 5C

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT, WASHINGTON, DC.
Financial Aspects of Dam Safety,
W83-04078 8A

INTERNATIONAL ENGINEERING CO., INC., SAN FRANCISCO, CA.
Optimum Capacity of a Run-of-River Plant,
W83-04167 8C

INTERNATIONAL RICE RESEARCH INST., LOS BANOS, LAGUNA (PHILIPPINES). DEPT. OF AGRONOMY.
Effect of Dry-Season Soil Management of Water Conservation for the Succeeding Rice Crop in a Tropical Soil,
W83-04066 3F

IONICS, INC., WATERTOWN, MA.
Solar Powered Electrodialysis - Part II,
W83-03921 3A

IOWA STATE UNIV., AMES.
Extraction of Priority Pollutants From Solids,
W83-03859 5D

IOWA STATE UNIV., AMES. DEPT. OF BOTANY.
Copper Susceptibility of Three Growth Stages of the Green Alga Haematococcus,
W83-03919 5G

IOWA STATE UNIV., AMES. DEPT. OF ECONOMICS.
Impact of Erosion Control Policies on Wildlife Habitat on Private Lands,
W83-04197 4D

IOWA UNIV., IOWA CITY. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Treatment of Recycle Streams From Thermal Sludge Conditioning,
W83-04161 5D

ITHACA COLL., NY. DEPT. OF BIOLOGY.
Zooplankton Diversity and Biomass in Recently Acidified Lakes,
W83-04103 2H

JOHANNESBURG CITY HEALTH DEPT. LABS. (SOUTH AFRICA).
Microbiology of Nutrient Removing Activated Sludge,
W83-03954 5D

The Location and Nature of Accumulated Phosphorus in Activated Sludge,
W83-03955 5D

JOHN DEERE PRODUCT ENGINEERING CENTER, WATERLOO, IA.
Computer Aid for Terrace Location,
W83-03957 4D

JOHNSON (BERNARD), INC., HOUSTON, TX.
Controlling Sulfides and Odors in Sewers. Part Two,
W83-04018 5D

KANSAS AGRICULTURAL EXPERIMENT STATION, MANHATTAN. DEPT. OF AGRONOMY.
Disposal of Feedlot-Lagoon Water by Irrigating Bromegrass: II. Soil accumulation and Leaching of Nitrogen,
W83-03986 5B

KANSAS AGRICULTURAL EXPERIMENT STATION, MANHATTAN. EVAPOTRANSPIRATION LAB.
The Influence of Water Availability on Winter Wheat Yields,
W83-04102 3F

KANSAS UNIV., LAWRENCE. DEPT. OF CIVIL ENGINEERING.
Multiport Diffuser Design for Discharging Pollutants in Alabama's Rivers,
W83-03912 8C

KANSAS WATER RESOURCES RESEARCH INST., MANHATTAN.
Movement of Water and Nitrate-Nitrogen in a Typical Silt Loam Soil of Western Kansas,
W83-03908 5G

Water Conservation by Optimal Irrigation Scheduling Based On Corn Dynamic Growth Model,
W83-03917 3F

KARLSRUHE UNIV. (GERMANY, F.R.). ENGLER-BUNTE INST.
Groundwater Pollution: A Threat to Public Water Supply. (Grundwasserverunreinigungen - Bedrohung Fur Die Offentliche Wasserversorgung.),
W83-04090 5G

Use of Particle Size Analysis in Drinking Water Preparation (Zum Einsatz Von Partikelgrossenanalysen In Der Trinkwasseraufbereitung),
W83-04091 5A

KENTUCKY WATER RESOURCES RESEARCH INST., LEXINGTON.
Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge,
W83-03903 7A

KITAMI INST. OF TECH., HOKKAIDO (JAPAN).
Determination of Traces of Copper in Tap Water, Iron and Steels by Electrothermal Zeeman Atomic Absorption Spectrometry with a Graphite Cupped Furnace,
W83-04189 5A

LAMONT-DOHERTY GEOLOGICAL OBSERVATORY, PALISADES, NY.
The Origin of Continental Shelf and Slope Water in the New York Bight and Gulf of Maine: Evidence from H2018/H2016 Ratio Measurements,
W83-03856 5B

LAVALIN, INC., MONTREAL (QUEBEC).
P.I.D. Regulation Revisited,
W83-04080 6B

LINDE A.G., HOLLRIEGELSKREUTH (GERMANY, F.R.).
Wastewater Treatment with Industrial Oxygen (Abwasserbehandlung Mit Technischem Sauerstoff),
W83-03927 5D

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF CHEMISTRY.
Continued Studies of Acid Rain and Its Effects on the Baton Rouge Area,
W83-04186 5B

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF CIVIL ENGINEERING.
A Continuum Mechanics Approach to Streamflow Modeling,
W83-03996 2E

LOUISIANA TECH UNIV., RUSTON. DEPT. OF AGRICULTURAL ENGINEERING.
Role of Mycorrhizae in Land Application of Municipal Wastewaters,
W83-04154 3C

MANITOBA UNIV., WINNIPEG. DEPT. OF CIVIL ENGINEERING.
Discussion: Optimization of Water Resources for Irrigation in East Jordan, by Janusz R. Rydzewski and Hani A-H. Rashid,
W83-03936 3F

MARYLAND UNIV., COLLEGE PARK. DEPT. OF AGRONOMY.
Nitrogen and Phosphorus Movement in Compost-Amended Soils,
W83-03898 5B

MASSACHUSETTS UNIV., AMHERST. DEPT. OF BOTANY.
Development of Groundwater on a Retreating Barrier Beach in Relation to Overwash and Dune Formation on Cape Cod, Massachusetts,
W83-03907 3B

MASSACHUSETTS UNIV., AMHERST. DEPT. OF CIVIL ENGINEERING.
An Analytical Model of Contaminant Migration in Shallow Aquifers,
W83-03909 5B

MASSACHUSETTS UNIV., AMHERST. DEPT. OF PLANT AND SOIL SCIENCES.
A Field Study of Solute Dispersion in a Shallow, Unconfined Aquifer,
W83-04030 2F

Chemical and Morphological Soil Characteristics in a New England Drainage-Toposequence,
W83-04036 2G

Field Testing of a Two-Dimensional Soil Moisture Model Simulating Water Table Fluctuations,
W83-04063 2G

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF CHEMICAL ENGINEERING.
Adsorption of Radium-226 by Biological Origin Absorbents,
W83-04114 5D

MEIDENSHA ELECTRIC MFG. CO. LTD., TOKYO (JAPAN). HYDRAULIC POWER GENERATION DIV.
Characteristics of Generators for Small Capacity Schemes,
W83-04168 8C

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF CROP AND SOIL SCIENCES.
Irrigation With Simulated Secondary Waste Water on Tiled Soil Cropped to Bromegrass and Corn,
W83-03985 3C

MINISTERE DE L'AGRICULTURE, PARIS (FRANCE).
The Use of Geotextiles in French Earth Dams,
W83-04082 8D

MINISTRY OF CONSTRUCTION, TOKYO (JAPAN). RIVER BUREAU.
Experience in the Use of Rolled Concrete,
W83-04169 8F

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CIVIL AND MINING ENGINEERING.
Low Energy Filtration Using Buoyant Media,
W83-04149 5D

MINNESOTA UNIV., ST. PAUL. DEPT. OF HORTICULTURAL SCIENCE AND LANDSCAPE ARCHITECTURE.
Drought Hardening of Crop Plants,
W83-04150 2I

MISSOURI UNIV.-ROLLA.
A Study of Adsorption of Colloids by Polymer Surfaces for Pretreatment of Water,
W83-04147 3A

MODENA UNIV. (ITALY). IST. DE IGIENE.
Investigation of Halogenated Organics Produced in 30 Drinking Water Supplies in Some Italian Districts (Modena, Reggio Emilia, and Mantova) (Indagine Sulla Presenza Di Modena, Reggio Emilia E Mantova),
W83-04023 5F

MONTREAL UNIV. (QUEBEC). LAB. DE PHYSIQUE NUCLEAIRE.
Asbestos Pollution Levels in River Water Measured by Proton-Induced X-Ray Emission (PIXE) Techniques,
W83-04097 5B

MONTREAL URBAN COMMUNITY (QUEBEC).
Integrated Control of Combined Sewer Regulators,
W83-03862 5G

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, GREENBELT, MD. LAB. FOR ATMOSPHERIC SCIENCES.
An Observational-Data Based Evapotranspiration Function for General Circulation Models,
W83-04116 2D

NATIONAL HYDROLOGY RESEARCH INST., OTTAWA (ONTARIO).
The Essence of Mathematical Models of Reservoir Storage,
W83-03852 4A

The Contamination and Protection of Aquifers,
W83-04020 5B

NATIONAL MUSEUM OF VICTORIA, MELBOURNE (AUSTRALIA).
Seasonal Variation in the Macroinvertebrate Fauna of Billabongs Along Magela Creek, Northern Territory,
W83-03891 2H

NEBRASKA UNIV. AT OMAHA. DEPT. OF CIVIL ENGINEERING.
Sludge Recycle and Reuse in Acid Mine Drainage Treatment,
W83-04200 5E

NEBRASKA UNIV., LINCOLN.
Enhancement of Water Quality in Nebraska Farm Ponds by Control of Eutrophication Through Biomanipulation,
W83-03995 5G

NEBRASKA UNIV.-LINCOLN. CENTER FOR AGRICULTURAL METEOROLOGY AND CLIMATOLOGY.
Agricultural Meteorology in China,
W83-03851 2B

NEBRASKA UNIV.-LINCOLN. DEPT. OF AGRICULTURAL ENGINEERING.
Increased Water Conservation and Percolation Through Improved Tillage Practices,
W83-04160 3F

NEBRASKA UNIV.-LINCOLN. DEPT. OF AGRONOMY.
Quantification of Soil Loss and Sediment Produced From Eroded Land,
W83-04037 2J

NEBRASKA UNIV.-LINCOLN. INST. OF AGRICULTURE AND NATURAL RESOURCES.
Sediment Fractionation of Cu, Ni, Zn, Cr, Mn, and Fe in One Experimental and Three Natural Marshes,
W83-03968 2L

NEBRASKA UNIV.-LINCOLN. SCHOOL OF LIFE SCIENCES.
Parasite Communities as Indicator Systems for Predicting the Effects of Surface Water Management Options on the Biota of Prairie Rivers,
W83-04155 6G

NEVADA UNIV. SYSTEM, RENO. BIORESOURCES CENTER.
Limnology of Lahontan Reservoir, 1980-1982,
W83-04144 5B

NEVADA UNIV. SYSTEM, RENO. DESERT RESEARCH INST.
Groundwater-Surface Water Interaction at Topaz Lake, Nevada,
W83-03920 2F

Nitrate in Nevada Playas,
W83-03994 5A

Isotope Hydrology of a Basin and Range Geothermal System,
W83-04000 2K

Reuse Versus Return Flows: Considerations for Selecting a Water Supply Strategy,
W83-04001 6B

Modeling and Analysis of Hydraulic Interchange of Surface and Groundwater,
W83-04145 2A

NEW BRUNSWICK DEPT. OF THE ENVIRONMENT, FREDERICTON. WATER RESOURCES BRANCH.
Flow Conveyance With Ice Cover for the Nashwaak River, N.B.,
W83-03853 2E

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA).
Prediction of Rainfall Excess and Soil Water Flux From Variable Storms on Layered Field Soils,
W83-03962 2A

NEW YORK STATE COLL. OF AGRICULTURE AND LIFE SCIENCES, ITHACA. DIV. OF NUTRITIONAL SCIENCES.
Decision Making and Risk Management by Individuals: Nitrate-Nitrogen in the Clifton Springs, New York Public Water Supply,
W83-04152 6F

NEWCASTLE UNIV. (AUSTRALIA). DEPT. OF CHEMISTRY.
The Influence of Surfactants on the Adsorption of Heavy Metal Ions by Clays,
W83-03935 5B

NORTH CAROLINA STATE UNIV. AT RALEIGH.
Sediment Pollution Control in North Carolina,
W83-03860 5G

The Use of Landsat MSS Digital Data in Water Quality Mapping of the Neuse River Estuary, N. C.,
W83-03918 7C

Variations in Monthly Precipitation Over North Carolina,
W83-03992 2B

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.
Phytoplankton Uptake and Sediment Release of Nitrogen and Phosphorus in the Chowan River, North Carolina,
W83-04146 5C

NORTH DAKOTA STATE UNIV., FARGO.
Mineralogical Controls on Toxic Element Contamination of Groundwater From Buried Electrical Utility Solid Wastes: I. Solid Waste Mineralogy II. Literature Review of Fly Ash Mineralogy,
W83-04004 5B

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF ZOOLOGY.
Water Resources Development of Prairie Pothole Lakes in North Dakota: Secondary Production,
W83-04005 2L

NORTH DAKOTA STATE UNIV., MANDAN. LAND RECLAMATION RESEARCH CENTER.
Hydraulic Conductivity of Soil as Determined from Cumulative Runoff,
W83-04071 2G

NORTH DAKOTA UNIV., GRAND FORKS. DEPT. OF CHEMISTRY.
Metal Binding Studies of Organic Materials in Water Systems,
W83-04003 5A

NORTH-EASTERN HILL UNIV., SHILLONG (INDIA). DEPT. OF BOTANY.
Environmental Effects on the Toxicity of Methyl Mercuric Chloride to Chlorella Vulgaris,
W83-04049 5C

O'BRIEN AND GERE ENGINEERS, INC., WHITE PLAINS, NY.
For.nation of Organic Chlorine in Public Water Supplies,
W83-04188 5F

OAK RIDGE NATIONAL LAB., TN.
Coal Conversion Solid Waste Disposal,
W83-03858 5E

Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms,
W83-03877 5C

A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models,
W83-03978 5B

OHIO STATE UNIV., COLUMBUS. DEPT. OF ENTOMOLOGY.
Surface Water Contamination by Insecticides: Data from Aquatic Insect Tests that Pertain to Water Quality Criteria,
W83-04139 5C

OKAYAMA UNIV. (JAPAN). DEPT. OF CHEMISTRY.
Spectrophotometric Determination of Phosphate in River Waters With Molybdate and Malachite Green,
W83-04128 5A

ONTARIO MINISTRY OF AGRICULTURE AND FOOD, GUELPH. PESTICIDE RESIDUE LAB.
Agriculture and Water Quality in the Canadian Great Lakes Basin: V. Pesticide Use in 11 Agricultural Watersheds and Presence in Stream Water, 1975-1977,
W83-03982 5B

OREGON STATE DEPT. OF ENVIRONMENTAL QUALITY, PORTLAND.
Effect of Tile Drainage on Disposal of Septic Tank Effluent in Wet Soils,
W83-03879 5D

OREGON STATE UNIV., CORVALLIS.
Economic Optimization of Irrigation,
W83-04007 3F

OREGON STATE UNIV., CORVALLIS. DEPT. OF ELECTRICAL AND COMPUTER ENGINEERING.
Discrete-Time, Cutback Furrow Irrigation,
W83-03958 3F

OREGON STATE UNIV., CORVALLIS. DEPT. OF FOREST ENGINEERING.
Effect of Hardwood Leaf Litter on Water Quality and Treatment in a Western Oregon Municipal Watershed,
W83-04142 5C

OREGON STATE UNIV., CORVALLIS. DEPT. OF MICROBIOLOGY.
Ecology and Virulence of Legionnaire's Disease Bacteria in Aquatic Habitats Near Mt. St. Helens,
W83-04151 5C

OREGON STATE UNIV., CORVALLIS. DEPT. OF SOIL SCIENCE.
Relationship of the Nature of Suspended Clay Minerals to Hydrologic Conditions,
W83-03966 2J

Plant and Soil Reactions to Nickel Ore Processed Tailings,
W83-03976 5B

ORISSA UNIV. OF AGRICULTURE AND TECHNOLOGY, BHUBANESWAR (INDIA). DEPT. OF PLANTS AND GENETICS.
Impact of Saline Water Irrigation on Some Crops and Their Varieties,
W83-03885 3C

OSAKA PREFECTURAL UNIV., SAKAI (JAPAN). LAB. OF ENVIRONMENTAL CHEMISTRY.
Continuous Flow Determination of Free Chlorine in Water,
W83-04192 5A

PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION, RIVERSIDE, CA.
Seasonal Variation in Nutrients of Floodplain and Upland Forest Soils of Central Illinois,
W83-04029 2G

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF AGRICULTURAL ENGINEERING.
Yield Response of Corn and Soybeans to Irrigation and Drainage on a Claypan Soil,
W83-03956 3F

PENNSYLVANIA UNIV., PHILADELPHIA. DEPT. OF CIVIL AND URBAN ENGINEERING.
Determination of Algal-Available Phosphorus on Soil and Sediment: A Review and Analysis,
W83-03979 5B

PERKIN-ELMER CORP., NORWALK, CT.
The Determination of Trace Elements in Natural Waters Using the Stabilized Temperature Platform Furnace,
W83-04118 5A

PERUGIA UNIV. (ITALY). CATTEDRA DI IGIENE.
Relationship Between Drinking Water Quality and Death from Cardiovasuclar Disease. III. Association Between Hardness and Chemical Constituents of Drinking Water (Correlazione Epidemiologica Tra Qualita' Delle Acque Potabilie Mortalita' Per Malattie Del Sistema Circolatorio. III. Rapporto Tra Durezza E I Differenti Componenti Delle Acque Condottate),
W83-04022 5C

PLM RESOURCE RECOVERY DIV., MALMO (SWEDEN).
Optimised Aerobic and Thermophilic Treatment of Municipal Sewage Sludges and Night Soils in a Continuous Operation,
W83-04198 5D

POITIERS UNIV. (FRANCE). LAB. DE CHIMIE DE L'EAU ET DES NUISANCES.
Chemical Evolution of Organic Micropollution During Ozonation of Filtered Water (Evolution Chimique Des Matieres Organiques Au Cours De L'Ozonation D'Une Eau De Surface Filtree),
W83-04058 5F

PRETORIA UNIV. (SOUTH AFRICA). DEPT. OF BIOCHEMISTRY.
Biochemical Changes Associated With Luxury Phosphate Uptake in a Modified Phoredox Activated Sludge System,
W83-03953 5D

PUNJAB AGRICULTURAL UNIV., LUDHIANA (INDIA).
Note on the Use of Irrigation Water and Yield of Transplanted Rice in Relation to Timing of Last Irrigation,
W83-04088 3F

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRONOMY.
The Mechanism of Raindrop Splash on Soil Surfaces,
W83-04034 2J

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: I. Accumulation of Suspension Particles,
W83-04068 5E

Flow of Kaolinite and Sewage Suspensions in Sand and Sand-Silt: II. Hydraulic Conductivity Reduction,
W83-04069 5E

PURDUE UNIV., LAFAYETTE, IN. WATER RESOURCES RESEARCH CENTER.
Critical Duration Analysis and Parameter Estimation in Illudas,
W83-04163 2A

QUEBEC UNIV., RIMOUSKI. DEPT. OF OCEANOGRAPHY.
Metal and Bacterial Contamination in New Jersey Estuarine Sediments,
W83-04171 5B

RHEINER MACHINENFABRIK WINDHOFF A.G. (GERMANY, F.R.).
Mechanical Cleaning Equipment for Stormwater Basins (Maschinelle Raumeinrichtungen Fur Regenbecken),
W83-03942 8C

RHODE ISLAND UNIV., KINGSTON. DEPT. OF CHEMISTRY.
A Resonance Raman Method for the Rapid Detection and Identification of Algae in Water,
W83-04119 5A

RIJKSINSTITUUT VOOR DE VOLKSGEZONDHEID, BILTHOVEN (NETHERLANDS). UNIT FOR RESIDUE ANALYSIS.
Chlorophenols in River Sediment in the Netherlands,
W83-03933 5A

ROHM AND HAAS CO., SPRING HOUSE, PA.
Final Pretreatment Filters for Reverse Osmosis Desalination,
W83-04162 3A

ROME UNIV. (ITALY). IST. DE CHIMICA.
Direct Determination of Trace and Subtrace Metals in Natural Waters by DPASV. The Use of Long-Lasting Sessile-Drop Mercury Electrodes Compared to Commercial Hanging-Drop Mercury Electrodes (Kemula Type),
W83-04122 5A

S.K.N. COLL. OF AGRICULTURE, JOBNER (INDIA).
A Study on the Evaluation of Water Quality With Respect to Boron for Wheat and Barley Growth on Loamy Sand Soil,
W83-03870 5C

A Study on the Effect of Residual Sodium Carbonate of Irrigation Water on the Properties of a Loamy Sand Soil and on Yield and Nutrient Uptake by Wheat and Barley,
W83-03888 3C

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF SOIL SCIENCE.
Comparison of the Soil Water Cycle in Clear-Cut and Forested Sites,
W83-03894 4C

SEVERN-TRENT WATER AUTHORITY (ENGLAND). LOWER TRENT DIV.
Agricultural Disposal of Sludges on a Historic Sludge Disposal Site,
W83-03945 5E

SEVILLE UNIV. (SPAIN). DEPT. OF BASIC AND APPLIED CHEMISTRY.
Determination of Trace Amounts of Molybdenum in Natural Waters by Solvent Extraction-Atomic-Absorption Spectrometry, After Chelating Ion-Exchange Preconcentration,
W83-04127 5A

SHELL DEVELOPMENT CO., HOUSTON, TX.
Effects of Ammonia and Phosphate Limitation on the Activated Sludge Treatment of Calcium-Containing Chemical Waste,
W83-04115 5D

SIMON FRASER UNIV., BURNABY (BRITISH COLUMBIA). DEPT. OF BIOLOGICAL SCIENCES.
Historic Changes in an Urban Watershed Determined by Pollen and Geochemical Analyses of Lake Sediment,
W83-04110 5C

SOCIETE D'ENERGIE DE LA BAIE JAMES, MONTREAL (QUEBEC).
Environmental Corrective Programs at the La Grande Complex (Les Amenagements Correctifs D'Environnement Au Complexe La Grande),
W83-04060 6G

SOUTH DAKOTA STATE UNIV., BROOKINGS. DEPT. OF CHEMISTRY.
Phosphate Extraction Using Fly Ash,
W83-03913 5F

SOUTH DAYTONA DEPT. OF BUILDING AND ENGINEERING, FL.
A U.S. Test for Insituform; or, How to Rebuild Pipe from Within,
W83-04130 8G

SOUTHERN ILLINOIS UNIV. AT CARBONDALE. DEPT. OF FORESTRY.
Infiltration Prediction Based on Estimation of Green-Ampt Wetting Front Pressure Head From Measurements of Soil Water Redistribution,
W83-04041 2G

Determination of Sorptivity Based on In-Situ Soil Water Redistribution Measurements,
W83-04044 2G

SOUTHERN WATER AUTHORITY, ST. LEONARDS (ENGLAND). EAST SUSSEX WATER AND DRAINAGE DIV.
The Effect of Variations in Analytical Methods on Trade Effluent Charges,
W83-03938 5A

SRI INTERNATIONAL, MENLO PARK, CA. PHYSICAL ORGANIC CHEMISTRY DEPT.
Photolysis of Nitroaromatics in Aquatic Systems. I. 2,4,6-Trinitrotoluene,
W83-04055 5B

STEWART, SVIRIDOV AND OLIVER, MARSHALLTOWN (SOUTH AFRICA).
Aspects of the Performance of Final Clarifiers in the Activated Sludge Process,
W83-03951 5D

STICHTING VOOR BODEMKARTERING, WAGENINGEN (NETHERLANDS).
Water Infiltration and Redistributing in a Silt Loam Subsoil with Vertical Worm Channels,
W83-04026 2G

SVENSKA TRAEFORSKNINGSINSTITUTET, STOCKHOLM.
Identification and Mutagenic Properties of Some Chlorinated Aliphatic Compounds in the Spent Liquor From Kraft Pulp Chlorination,
W83-04094 5A

SYBRON CORP., BIRMINGHAM, NJ.
The Influence of Salt Concentration on the Hydraulic Properties of Ion Exchange Resins,
W83-04132 5D

TASMANIA UNIV., HOBART (AUSTRALIA). DEPT. OF ZOOLOGY.
Use of the Mussel Mytilus-Edulis-Planulatus (Lamarck) in Monitoring Heavy Metal Levels in Seawater,
W83-04053 5A

TECHNICAL UNIV. OF DENMARK, LYNGBY. DEPT. OF SANITARY ENGINEERING.
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W83-03952 5D

TECHNISCHE UNIV., DRESDEN (GERMAN D.R.). BEREICH HYDROBIOLOGIE.
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W83-04047 5A

TECHNISCHE UNIV., MUNICH (GERMANY, F.R.). LEHRSTUHL FUER HYDROGEOLOGIE AND HYDROCHEMIE.
Hydrogeological and Hydrogeochemical Studies of the Unsaturated Flow in a Gravel Aquifer. Part I. Planning and Construction of an Accessible Shaft Enabling the Sampling of Percolation Water and Gases (Hydrogeologische und Hydrogeochemische Untersuchungen in Der Ungesattigten Zone Eines Kiesgrundwasserleiters. Teil 1),
W83-03940 2F

TENNESSEE UNIV., KNOXVILLE.
Raw Water Bromide: Levels and Relationship to Distribution of Trihalomethanes in Finished Drinking Water,
W83-03916 5F

TEXAS AGRICULTURAL EXPERIMENT STATION, COLLEGE STATION.
Time and Frequency of Irrigation Effects on Sunflower Production and Water Use,
W83-04039 3F

Spatial Variability of Soil Hydraulics and Remotely Sensed Soil Parameters,
W83-04062 2G

TEXAS CHRISTIAN UNIV., FORT WORTH. DEPT. OF GEOLOGY.
Application of Aerial Photographic and Computer Analysis to the Usle for Areawide Erosion Studies,
W83-04185 2J

TEXAS UNIV. AT AUSTIN. GEOTECHNICAL ENGINEERING CENTER.
Measurement of Hydraulic Conductivity of Unsaturated Soils with Thermocouple Psychrometers,
W83-04025 2G

TEXAS UNIV. AT EL PASO. DEPT. OF CHEMICAL ENGINEERING.
Evaluation of Peak Prediction Practices in Relation to Floods, Flash Floods, and Dam Safety Act,
W83-04138 2E

TEXAS WATER RESOURCES INST., COLLEGE STATION.
Water Conservation With Urban Landscape Plants,
W83-04140 3D

THAMES WATER AUTHORITY (ENGLAND). COTSWOLD DIV.
Cirencester Carrousel Plant: Some Process Considerations,
W83-03944 5D

Initial Operating Experiences at Cirencester Carrousel Plant,
W83-03947 5D

THESSALONIKI UNIV., SALONIKA (GREECE). ENVIRONMENTAL POLLUTION CONTROL LAB.
Heavy Metals in Marine Organisms of the North Aegean Sea, Greece,
W83-04051 5B

Concentration of Heavy Metals in Seawater and Sediments from the Northern Aegean Sea, Greece,
W83-04056 5B

TORONTO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Velocity and Suspended Solids Distribution in Settling Tanks,
W83-04183 5D

TOYOHASHI UNIV. OF TECHNOLOGY (JAPAN). SCHOOL OF MATERIALS SCIENCE.
Determination of Deuterium Oxide in Water by Reversed-Phase High-Performance Liquid Chromatography,
W83-04190 5A

TRANSAMERICA DELAVAL, INC., SANTA MONICA, CA. BIPHASE ENERGY SYSTEMS.
Biphase Turbine for Reverse Osmosis Desalination,
W83-03910 8C

TRENT UNIV., PETERBOROUGH (ONTARIO).
Relationship Between Body-Lead Concentration of Mysis Relicta and Sediment-Lead Concentration in Kootenay Lake, B.C.,
W83-04104 5C

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W83-04187 5D

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Evaluation of a Ground Transient Electromagnetic Remote Sensing Method for the Deep Detection and Monitoring of Salt Water Interfaces,
W83-03899 7B

UNIVERSITY OF SOUTHERN COLORADO, PUEBLO. DEPT. OF CHEMISTRY.
Simultaneous Determination of Sixteen Major and Minor Elements in River Sediments by Energy-Dispersive X-Ray Fluorescence Spectrometry After Fusion in Lithium Tetraborate Glass,
W83-04194 5A

Evaluation of Methods Based on Acid Extraction and Atomic Absorption Spectrometry for Multi-Element Determinations in River Sediments,
W83-04195 5A

UNIVERSITY OF THE WEST INDIES, ST. AUGUSTINE (TRINIDAD AND TOBAGO). DEPT. OF SOIL SCIENCE.
Runoff and Soil Loss in Trinidad Under Different Crops and Soil Management,
W83-04028 4D

UNIVERSITY OF WESTERN ONTARIO, LONDON. DEPT. OF PLANT SCIENCES.
Predicting Depth to the Water Table Based on Species Presence on an Oregon Coast Deflation Plain,
W83-04193 2F

UOP, INC., ST. PAUL, MN. JOHNSON DIV.
Johnson Velocity Meter System Proves its Worth,
W83-04076 8B

UTAH AGRICULTURAL EXPERIMENT STATION, LOGAN.
Predicting Crop Production as Related to Drought Stress Under Irrigation,
W83-03904 3F

UTAH STATE UNIV., LOGAN. COLL. OF NATURAL RESOURCES.
Defining Stream Fish Microhabitat Requirements for Water Project Planning,
W83-03915 6G

UTAH WATER RESEARCH LAB., LOGAN.
Hydraulics and Numerical Solutions of Steady-State but Spatially Varied Debris Flow,
W83-03914 8B

Alteration of Availability of Heavy Metals to Aquatic Microflora by Complexation with Organics Associated with Oil Shale Development,
W83-04006 5B

Polycyclic Aromatic Hydrocarbons-Are They a Problem in Processed Oil Shales,
W83-04148 5B

An Economic Evaluation of Benefits and Costs of Maintaining Instream Flows,
W83-04156 6B

VERSAR, INC., SPRINGFIELD, VA.
Assessment of Water Recycle and Reuse Potential in the Inorganic Chemicals Industry,
W83-04164 3E

VICTORIA UNIV. (BRITISH COLUMBIA). DEPT. OF BIOCHEMISTRY AND MICROBIOLOGY.

Hepatic Metallothionein in Rainbow Trout (Salmo Gairdneri) as an Indicator of Metal Pollution in the Campbell River System,
W83-03854 5C

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF CHEMICAL ENGINEERING.

Biological Regeneration of Activated Carbon,
W83-04133 5D

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF CHEMISTRY.

Potentiometric Stripping with Matrix Exchange Techniques in Flow Injection Analysis of Heavy Metals in Ground-Water,
W83-04191 5A

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF CIVIL ENGINEERING.

Institutional Framework for Rural Water Supply: A Comparative Analysis of North Caroline, South Carolina, and Virginia,
W83-03902 6E

A Probabilistic Model for Assessment of Plant Water Availability,
W83-03972 2G

VIRGINIA STATE WATER CONTROL BOARD, RICHMOND. BUREAU OF WATER CONTROL MANAGEMENT.

Using EPA's Computerized Data Base (STORET) to Analyze for Agricultural Water Pollution,
W83-03895 5B

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.

Productivity Measurement and the Storage of Oxygen in the Aerenchyma of Aquatic Macrophytes,
W83-03890 2H

VSESOYUZNYI NAUCHNO-ISSLEDOVATEL'SKII INST. GIDROTEKHNIKI I MELIORATSII, MOSCOW (USSR).

Embankment Dams with Polyethylene and Steel Membranes,
W83-04077 8G

VYZKUMNY USTAV BALNEOLOGICKY, MARIENBAD (CZECHOSLOVAKIA).

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W83-04046 5F

VYZKUMNY USTAV VODOHOSPODARSKY, OSTRAVA (CZECHOSLOVAKIA).

Evaluation of Correlations Between Absorbance at 254 NM and Cod of River Waters,
W83-03934 5A

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Deficit, High-Frequency Sprinkler Irrigation of Wheat,
W83-04032 3F

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W83-04050 5A

WATER RESEARCH CENTRE, STEVENAGE (ENGLAND).

Oxygenated Activated-Sludge Process: Evaluation at Palmersford,
W83-03930 5D

Effective Use of STOM,
W83-03931 5D

Inactivation of Salmonella During Anerobic Digestion of Sewage Sludge,
W83-04184 5D

WATER RESEARCH COMMISSION, PRETORIA (SOUTH AFRICA).

Water Recycling for Domestic and Agricultural Applications: State of the Art,
W83-03969 3C

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W83-04054 5C

WAYNE STATE UNIV., DETROIT, MI.

Uncertainty Analysis of a Complex Reactor System Using Monte Carlo Procedures,
W83-04134 5D

WESLEYAN UNIV., MIDDLETOWN, CT.

Analysis of Chemistry Associated With Ozonolysis of Organic Pollutant Molecules in Water,
W83-04141 5A

WEST VIRGINIA UNIV., MORGANTOWN. WATER RESEARCH INST.

Effects on Soils and Vegetation of Plant Nutrients and Heavy Metals From Wastewater-Treatment-Plant Sludges Disposed on Land,
W83-03905 5E

WILLIAM AND MARY COLL., GLOUCESTER POINT, VA. INST. OF MARINE SCIENCE.

Comparison of Estuarine Species Sensitivities to Three Toxicants,
W83-03878 5C

WINDSOR UNIV. (ONTARIO). ENVIRONMENTAL MICROBIOLOGY RESEARCH LAB.

Seasonal Fluctuations in River Bacteria as Measured by Multivariate Statistical Analysis of Continuous Cultures,
W83-04059 2H

WISCONSIN UNIV.-MADISON. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.

Decomposition of Solid Waste in Test Lysimeters,
W83-03861 5E

WISCONSIN UNIV.-MADISON. LAB. OF LIMNOLOGY.

Low pH and the Absence of Fish Species in Naturally Acidic Wisconsin Lakes: Inferences for Cultural Acidification,
W83-04108 5C

WISCONSIN UNIV.-MADISON. WATER RESOURCES CENTER.

Role of Conservation Easements in Inland Lake Management,
W83-04153 6E

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA.

Characteristics of Sediment and Organic Carbon Export From Pristine Boreal Forest Watersheds,
W83-04109 2F

ZARAGOZA UNIV. (SPAIN). DEPT. OF ANALYTICAL CHEMISTRY.

Spectrophotometric and Fluorimetric Determination of Boron in Soils, Plants and Water by Extraction with 2-Methylpentane-2,4-Diol in Isobutyl Methyl Ketone,
W83-04129 5A

ACCESSION NUMBER INDEX

W83-03851 2B
W83-03852 4A
W83-03853 2E
W83-03854 5C
W83-03855 2H
W83-03856 5B
W83-03857 6E
W83-03858 5E
W83-03859 5D
W83-03860 5G
W83-03861 5E
W83-03862 5G
W83-03863 4B
W83-03864 8B
W83-03865 8B
W83-03866 3C
W83-03867 3F
W83-03868 3F
W83-03869 3F
W83-03870 5C
W83-03871 3F
W83-03872 2B
W83-03873 3F
W83-03874 5C
W83-03875 3F
W83-03876 5C
W83-03877 5C
W83-03878 5C
W83-03879 5D
W83-03880 2L
W83-03881 2A
W83-03882 2A
W83-03883 2G
W83-03884 2B
W83-03885 3C
W83-03886 4A
W83-03887 3F
W83-03888 3C
W83-03889 3C
W83-03890 2H
W83-03891 2H
W83-03892 5C
W83-03893 5B
W83-03894 4C
W83-03895 5B
W83-03896 5B
W83-03897 5B
W83-03898 5B
W83-03899 7B
W83-03900 5B
W83-03901 5F
W83-03902 6E
W83-03903 7A
W83-03904 3F
W83-03905 5E
W83-03906 7C
W83-03907 3B
W83-03908 5G
W83-03909 5B
W83-03910 8C
W83-03911 5B
W83-03912 8C
W83-03913 5F
W83-03914 8B
W83-03915 6G
W83-03916 5F
W83-03917 3F
W83-03918 7C
W83-03919 5G
W83-03920 2F
W83-03921 3A
W83-03922 6D
W83-03923 5C
W83-03924 5B
W83-03925 5D
W83-03926 5D
W83-03927 5D
W83-03928 5D
W83-03929 5D
W83-03930 5D
W83-03931 5D
W83-03932 5C
W83-03933 5A
W83-03934 5A
W83-03935 5B
W83-03936 3F
W83-03937 5B
W83-03938 5A
W83-03939 8G
W83-03940 2F
W83-03941 5D
W83-03942 8C
W83-03943 6E
W83-03944 5D
W83-03945 5E
W83-03946 5D
W83-03947 5D
W83-03948 2G
W83-03949 4A
W83-03950 6E
W83-03951 5D
W83-03952 5D
W83-03953 5D
W83-03954 5D
W83-03955 5D
W83-03956 3F
W83-03957 4D
W83-03958 3F
W83-03959 3F
W83-03960 4D
W83-03961 2A
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W83-03963 2J
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W83-03968 2L
W83-03969 3C
W83-03970 5E
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W83-03984 5B
W83-03985 3C
W83-03986 5B
W83-03987 5B
W83-03988 5B
W83-03989 2K
W83-03990 4C
W83-03991 5F
W83-03992 2B
W83-03993 7C
W83-03994 5A
W83-03995 5G
W83-03996 2E
W83-03997 5F
W83-03998 4B
W83-03999 5A
W83-04000 2K
W83-04001 6B
W83-04002 5D
W83-04003 5A
W83-04004 5B
W83-04005 2L
W83-04006 5B
W83-04007 3F
W83-04008 2J
W83-04009 2A
W83-04010 2A
W83-04011 3B
W83-04012 7C
W83-04013 2E
W83-04014 7C
W83-04015 10C
W83-04016 5A
W83-04017 6G
W83-04018 5D
W83-04019 2B
W83-04020 5B
W83-04021 2C
W83-04022 5C
W83-04023 5F
W83-04024 6B
W83-04025 2G
W83-04026 2G
W83-04027 2G
W83-04028 4D
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W83-04031 2G
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W83-04040 2G
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W83-04042 2G
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W83-04044 2G
W83-04045 2H
W83-04046 5F
W83-04047 5A
W83-04048 5D
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W83-04060 6G
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W83-04065 6F
W83-04066 3F
W83-04067 2J
W83-04068 5E
W83-04069 5E
W83-04070 7B
W83-04071 2G
W83-04072 3F
W83-04073 5D
W83-04074 5D
W83-04075 5D
W83-04076 8B
W83-04077 8G
W83-04078 8A
W83-04079 8C
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W83-04081 8D
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W83-04086 5D
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W83-04090 5G
W83-04091 5A
W83-04092 2F
W83-04093 5B
W83-04094 5A
W83-04095 5B
W83-04096 2K
W83-04097 5B
W83-04098 5B
W83-04099 5D
W83-04100 5E
W83-04101 5E
W83-04102 3F
W83-04103 2H
W83-04104 5C
W83-04105 5B
W83-04106 5C
W83-04107 2H
W83-04108 5C
W83-04109 2E
W83-04110 5C
W83-04111 3F
W83-04112 3C
W83-04113 3F
W83-04114 5D
W83-04115 5D
W83-04116 2D
W83-04117 2L
W83-04118 5A
W83-04119 5A
W83-04120 3F
W83-04121 3B
W83-04122 5A
W83-04123 5A
W83-04124 5A
W83-04125 5A
W83-04126 5A
W83-04127 5A
W83-04128 5A
W83-04129 5A
W83-04130 8G
W83-04131 5B
W83-04132 5D
W83-04133 5D
W83-04134 5D
W83-04135 4A
W83-04136 3F
W83-04137 2A
W83-04138 2E
W83-04139 5C
W83-04140 3D
W83-04141 5A
W83-04142 5C
W83-04143 3A
W83-04144 5B
W83-04145 2A
W83-04146 5C
W83-04147 3A
W83-04148 5B
W83-04149 5D
W83-04150 2I
W83-04151 5C
W83-04152 6F
W83-04153 6E
W83-04154 3C
W83-04155 6G
W83-04156 6B
W83-04157 2F
W83-04158 7C
W83-04159 5B
W83-04160 3F
W83-04161 5D
W83-04162 3A
W83-04163 2A
W83-04164 3E
W83-04165 5C
W83-04166 8C
W83-04167 8C
W83-04168 8C
W83-04169 8F
W83-04170 6C
W83-04171 5B
W83-04172 5D
W83-04173 5B
W83-04174 5C
W83-04175 5F
W83-04176 5A
W83-04177 5D
W83-04178 5D
W83-04179 5D
W83-04180 5E
W83-04181 5D
W83-04182 5D
W83-04183 5D
W83-04184 5D
W83-04185 2J
W83-04186 5B

W83-04187 5D
W83-04188 5F
W83-04189 5A
W83-04190 5A
W83-04191 5A
W83-04192 5A
W83-04193 2F
W83-04194 5A
W83-04195 5A
W83-04196 3A
W83-04197 4D
W83-04198 5D
W83-04199 5B
W83-04200 5E

Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

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